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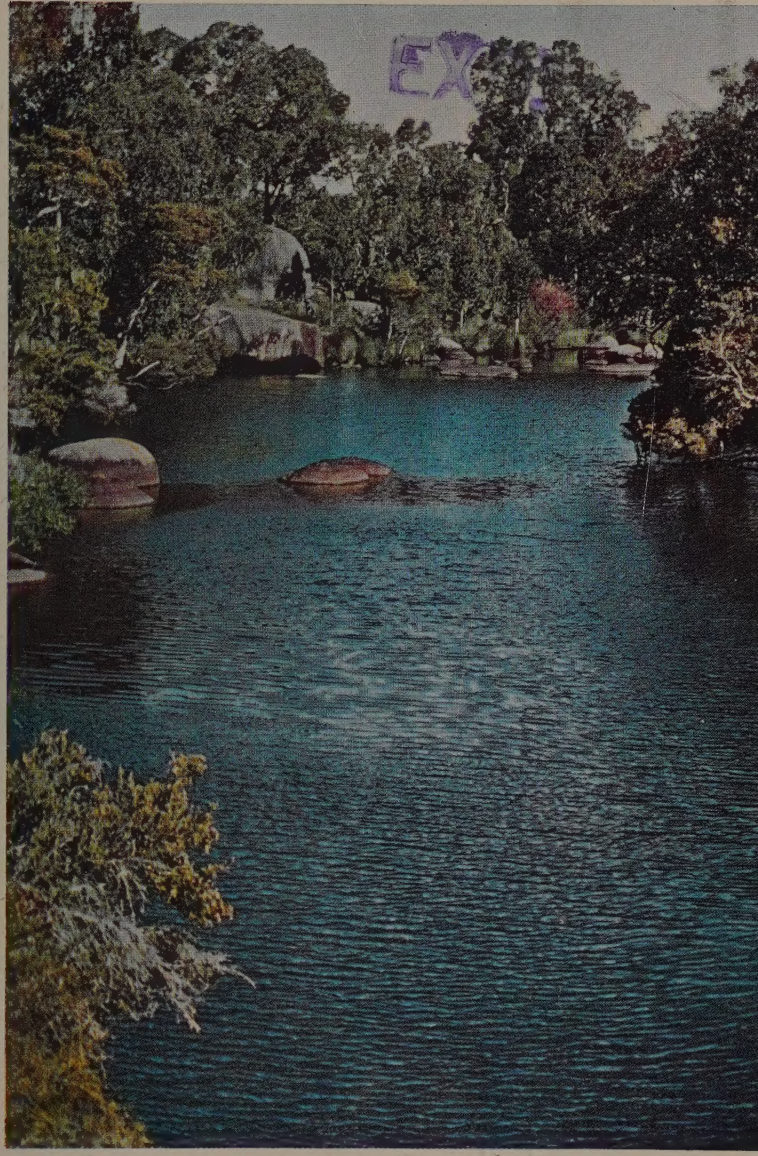

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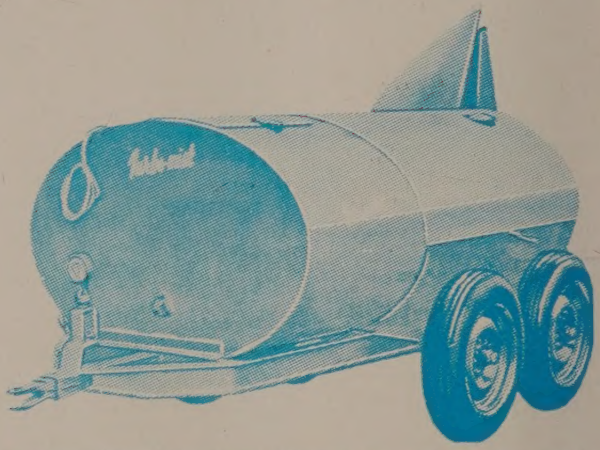

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WESTERN AUSTRALIA

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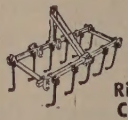

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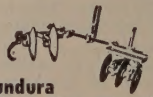

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The Naturalised Clovers of Western Australia

By C. A. GARDNER,
Government Botanist

AS this article was written primarily for farmers and others with little or no training in botany, it may be fitting to commence with a few notes on the plants which are referred to as clovers. All the true clovers are species of Trifolium (from the Latin, tres—three and folium—leaf). Because of this, the terms "clover" and "trefoil" are somewhat loosely applied and some of the yellow-flowered clovers are commonly but incorrectly referred to as trefoils.

The clovers are very closely related to the true trefoils, which are all species of *Medicago,* and not to be confused with the "birdsfoot trefoils" which are species of *Lotus.*

Apart from bearing similarly-coloured flowers, some of the yellow-flowered clovers also closely resemble the trefoils, in that they have a similar type of leaf, in which the central or terminal leaflet in each group of three is on a longer stalklet than its lateral neighbours. Such a leaf is described as "pinnate" to distinguished it from the "digitate" leaf in which the three leaflets are carried on stalklets of equal lengths (see Plate A).

In general, apart from the exceptions mentioned, the true clovers carry leaflets that are equally stalked (digitate) whereas the trefoils are usually pinnate. The stipules or leaf appendages (see Plate A) are not markedly fringed in the case of the clovers, whereas in the trefoils they are often deeply fringed.

These characteristics are not always constant but serve as a general guide in differentiating between the clovers and trefoils.

The only constant difference is in the pods, which in the clovers are straight, small and more or less concealed by the withered flowers.

In the trefoils, the pods are curved (as in lucerne, for example) or spirally coiled (as in burr trefoil).

THERE ARE NO NATIVE CLOVERS

The clovers are mainly indigenous to the temperate and sub-tropical regions of the Northern Hemisphere with a few species in the mountains of tropical America, in South America and in South Africa.

All the clovers now found in Australia are of European or Eastern Mediterranean origin—the greater number being from Syria and Palestine.

This article contains keys and descriptions covering the 29 clovers naturalised in South-Western Australia, also six other species which, under experimental cultivation, are showing promise as pasture plants.

These are bladder clover, dry-head clover, *Trifolium balansae. T. hirtum, T. Carmelii,* and *T. Desvauxii.*

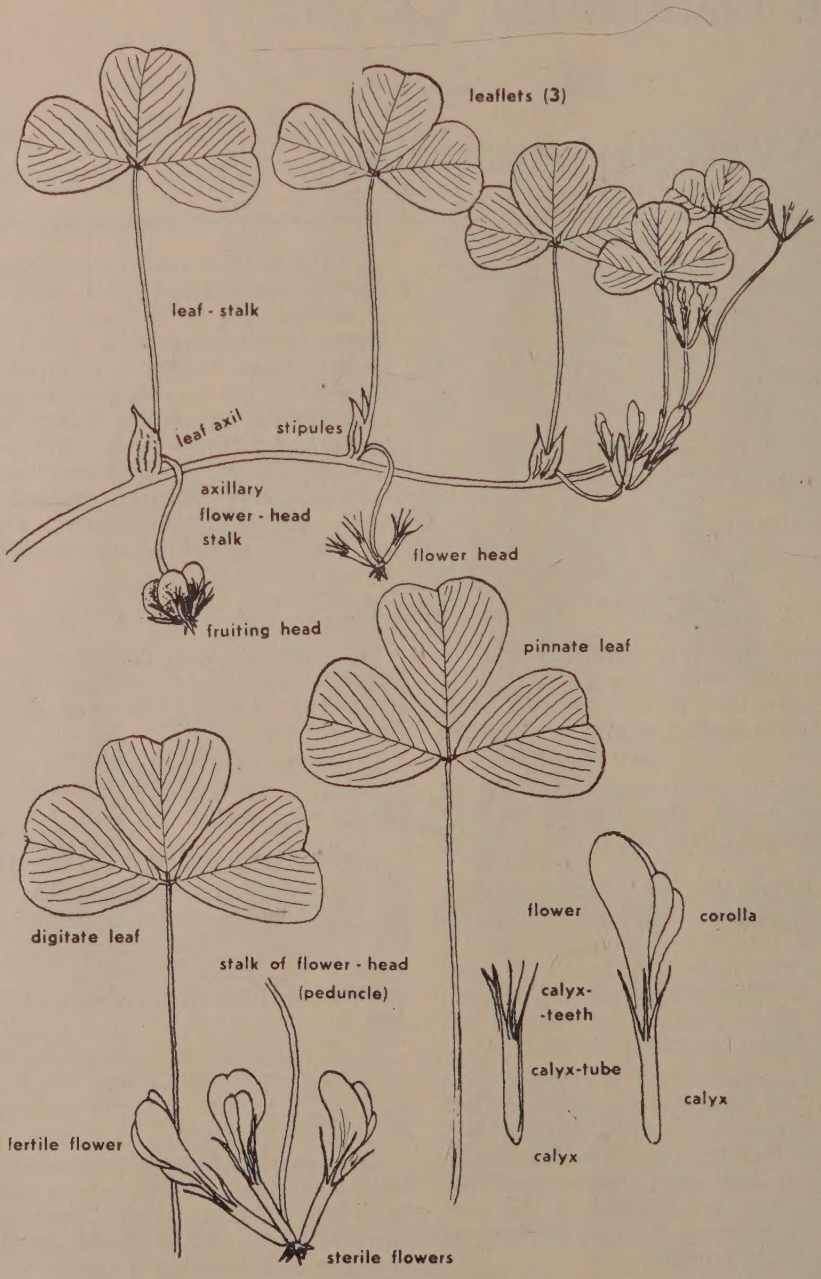
leaflets (3)
leaf - stalk
leaf axil
stipules
axillary
flower - head
stalk
flower head
fruiting head
pinnate leaf
digitate leaf
stalk of flower - head
(peduncle)
fertile flower
sterile flowers
flower
corolla
calyx-
-teeth
calyx-tube
calyx
calyx

PLATE A.

BOTANICAL TERMS

An attempt has been made in this article to describe the plants in terms which are readily understandable by the layman. Two keys to identification of the various clover species have been incorporated. One is for the trained worker familiar with botanical terms, the other is based on common characters which the farmer should have no difficulty in understanding.

Botanists are often accused of talking and writing in language that is almost incomprehensible to the layman, but there is a very sound reason for using these specialised terms.

When dealing with thousands of plants, many of which are similar in general appearance and only differ in slight details, it is essential that the botanist should be able to describe the various characters briefly and accurately.

Most of the words used by botanists convey a precise shade of meaning that would require several words to explain to the layman. The words "pinnate" and "digitate" used earlier in this article are cases in point.

Where botanical terms have been used to avoid unnecessarily lengthy descriptions, the meaning of such terms can usually be obtained by referring to the illustrations. Plate A, for instance shows the names of plant organs. Where leaf-shapes are given in technical terms, a glance at the plates or the text illustrations should provide the meaning.

The terms "axillary" and "terminal" refer to organs such as flower-heads which arise in two ways—from the angle formed by the base of the leaf-stalk and the stem (the leaf-axil), or when borne at the end of the stem or its branch.

"Stalkless" has been used instead of "sessile," and "individual flower-stalks" refer to the stalks of the individual flowers in the flower-cluster or "head."

The natural group to which subterranean clover belongs, contains three species which have, as a common characteristic, the presence of imperfect flowers in the middle, which, in the case of subterranean clover become outermost when the pods develop. Reference to the descriptions and the illustrations should overcome any difficulty here. Similarly with strawberry clover, shaftal clover and woolly clover, it may be necessary to observe plants in an advanced stage of flowering in order to understand the changes which take place in the form of the calyx when the plant is in pod.

THE CLOVERS—A GENERAL DESCRIPTION

THE true clovers are annual or perennial herbs. The leaves consist of three leaflets which are digitately, or pinnately arranged at the top of the common petiole or stalk; when digitate the leaflets are on short stalklets all of the same length; when pinnately arranged the middle leaflet is on a longer stalk.

The flowers are formed in dense clusters usually referred to as "heads." Actually the flowers, with few exceptions have short stalks or pedicels, to distinguish them from the common stalk, or peduncle of the flower-head. The heads vary from globular, i.e. more or less spherical in outline, to egg-shaped (ovate), oblong, or long and narrow (cylindrical.)

The calyx, the cup-shaped organ which surrounds the base of the corolla, stamens and young pod, consists of a distinct tube with five tooth-like projections—the calyx teeth. These may be all alike, or of different shape and size, in which case the lowest is usually longer than the other four. The petals are those of the typical pea flower, consisting of the outermost standard, the wings, and the keel, the latter enclosing the stamens and ovary. The standard is longer than the wings and keel, and the wings longer than the keel. All of these have narrow stalk-like bases.

The stamens are ten in number, the lowest nine being united to form a sheath which surrounds the ovary (immature pod) and style, the uppermost stamen being free.

The pod of the true clovers is small, and usually included in the calyx and withered corolla. The number of seeds varies from one to six. This pod remains unopened, or it opens by splitting longitudinally into two halves, or (as in red clover)it opens transversely, the upper half falling off as a lid to the pod. The flowers are insect-pollinated.

There are approximately 290 species of *Trifolium*.

KEY TO THE SECTIONS

A. Flowers in the head of two kinds the outer ones alone fertile and complete, the inner sterile and reduced to a solid calyx — Sect. I. *Calycomorphum*.

A. Flowers in the head all alike, all or mostly fertile.

B. Upper lip of the fruiting calyx hooded, much larger than the lower lip .... — Sect. II. *Galearia*.

B. Calyx symmetrical swollen or enlarged, or remaining unchanged.

C. Calyx symmetrically inflated or enlarged, in fruit, 20-nerved and prominently reticulate between the nerves .... — Sect. III. *Vesicastrum*.

C. Calyx not inflated, or if so, then 5-nerved.

D. Flowers each in the axil or a small bract, pedicellate.

E. Flowers yellow; calyx usually 5-nerved, the three anterior lobes distinctly larger than the two posterior .... — Sect. IV. *Chronosemium*.

E. Flowers red, pink, purple or white; calyx usually 10-or more-nerved.

F. Calyx-teeth 3-nerved, recurved at maturity; corolla small .... — Sect. V. *Micranthemum*.

F. Calyx-lobes straight; corolla much longer than the calyx .... — Sect. VI. *Amoria*.

D. Flowers all or mostly without bracts, sessile or subsessile.

E. Calyx throat neither constricted by a callous rim nor nearly to completely closed by two callosities; calyx-lobes not spreading.

F. Calyx-tube 20-nerved .... — Sect. VII. *Eikosineurum*.

F. Calyx-tube 10-nerved ....

G. Annuals; corolla not longer than the calyx; flowers pink .... — Sect. VIII. *Agriophyllum*.

G. Perennial: corolla much longer than the calyx; flowers purple .... — Sect. IX. *Leimonophyllum*.

E. Calyx throat constricted or closed by a callous ring or by two marginal callosities which either completely close the throat or confine it to a straight slit.

F. Throat of calyx widely elliptical .... — Sect. X. *Astrostoma*.

F. Throat of calyx closed or reduced to a narrow slit.

G. Annuals.

H. Lateral nerves of the leaflets straight, unthickened, directed forward obliquely, corolla glabrous, deciduous; calyx-lobes strongly spreading at maturity — Sect. XI. *Orthoneurum*.

H. Lateral nerves of the leaflets with thickened ends, curving outwards; calyx-lobes not nerved .... — Sect. XII. *Camptoneurum*.

G. Perennials .... — Sect. XII. *Macrobiotum*.

KEY TO THE SPECIES

Section I.—CALYCOMORPHUM

A. Sterile flowers formed after the development of the fertile flowers; calyx teeth glabrous or almost so; pods usually ripening underground .... 1. *T. subterraneum* L.

A. Sterile flowers formed simultaneously with the fertile flowers; calyx-tube densely hairy or woolly; fruiting heads deciduous, wind-distributed.

B. Fertile flowers 15-20 .... *2. *T. globosum* L.

B. Fertile flowers two .... 3. *T. pilulare* Boiss.

Section II.—GALEARIA

A. Annuals; heads without an involucre of bracts.

B. Fruiting calyx globular, reticulate, densely tomentose, with two short teeth of the upper lip concealed in the wool .... 4. *T. tomentosum* L.

B. Fruiting calyx with a conical upper lip, the two long teeth apical and conspicuous .... 5. *T. resupinatum* L.

A. Perennials, rooting at the nodes; flower-heads on peduncles longer than the leaves, surrounded by an involucre of bracts nearly as long as the calyces and united in the lower part 6. *T. fragiferum* L.

Section III.—VESICASTRUM

A. Calyx 20-nerved, the lobes at length recurved; standard acute *7. *T. spumosum* L.

A. Calyx ± 35-nerved, the tube marked by two villous longitudinal lines .... *8. *T. xerocephalum* Fenzl.

Section IV.—CHRONOSEMIUM

A. Standard narrowed at the base, ± spoon-shaped, grooved at the apex; style shorter than the pod; flowers 5-7mm. long.

B. Stipules half-ovate; flowers 5 mm. long .... 9. *T. campestre* Schreb.

B. Stipules linear-oblong; flowers 7 mm. long .... 10. *T. aureum* Poll.

A. Standard not narrowed at the base, keeled on the back, flowers 2-3 mm. long.

B. Leaves pinnate; pedicels rather stout, shorter than the calyx-tube; standard entire; flower-heads usually 10-20 flowered, the flowers rarely reduce to four .... 11. *T. dubium* Sibth.

B. Leaflets subsessile; pedicels slender, as long as the calyx-tube or longer; standard notched; heads 2-6 flowered .... 12. *T. micranthum* Viv.

Section V.—MICRANTHEMUM

A. Flower-heads sessile in the leaf-axils, the flowers sessile.

B. Calyx-lobes overlapping at the base, the base broad and rounded; standard pink .... 13. *T. glomeratum* L.

B. Calyx-lobes tapering from a triangular base, the bases not overlapping; standard white .... 14. *T. suffocatum* L.

A. Flower-heads on short slender peduncles, recurved in fruit; pedicels as long as the calyx-tube or slightly longer .... 15. *T. cernuum* Brot.

Section VI.—AMORIA

A. Annual; flower-heads 4 cm. diameter, the upper flowers on long pedicels. Flowers large .... *16. *T. balansae* Boiss.

A. Perennials; flower-heads 2 cm. diameter or less; flowers medium-sized; upper pedicels scarcely longer than the lower.

B. Erect or ascending; stem hollow .... 17. *T. hybridum* L.

B. Prostrate and creeping, rooting at the nodes; stems solid 18. *T. repens* L.

* These species are not yet naturalised

Section VII.—EIKOSINEURUM

A. Heads sessile, sheathed by the uppermost opposite leaves, rarely in pairs, and then one peduncled; plant villous; upper stipules orbicular, sometimes leafless.

B. Calyx half as long as the purple corolla, the lobes setaceous, equal, twice as long as the tube .... *19. *T. hirtum* All.

B. Calyx nearly as long as the white or purplish corolla, the lobes equal, linear, as long as the villous calyx-tube .... 20. *T. Cherleri* L.

A. Heads usually peduncled; plant sparingly appressed-hairy; free part of the stipules lanceolate-subulate; calyx shorter than the corolla, the lobes 5-nerved, more than twice as long as the glabrous tube .... 21. *T. lappaceum* L.

Section VIII.—AGRIOPHYLLUM

A. Heads ultimately a cylindrical spike, peduncled; calyx-lobes usually 2-6 times as long as the tube, longer than the corolla; stipules caudate .... 22. *T. arvense* L.

A. Heads predominantly sessile; calyx-lobes shorter than the tube and as long as corolla .... 23. *T. striatum* L.

Section IX.—LEIMONOPHYLLUM

Perennial; peduncles lateral; flowers purple .... 24. *T. pratense* L.

Section X.—ASTROSTOMA

A. Stipules acute, entire; flowers pale pink or white, in ovoid spikes.

B. Corolla 2-6 mm. long, persistent; standard subequal to the lower petals .... 25. *T. ligusticum* Balb.

B. Corolla 1-2 cm. long, deciduous; flowers white, the standard much longer than the lower petals.

C. Leaflets oblong-elliptical to oblong; calyx-lobes thick at the base, nerveless .... *26. *T. carmelii* Boiss.

C. Leaflets ovate-elliptical; calyx-lobes 3-nerved at the base .... 27. *T. Alexandrinum* L.

A. Stipules broad, obtuse, often dentate; flowers in elongated spikes, the corolla red .... 28. *T. incarnatum* L.

Section XI.—ORTHONEURUM

A. Throat of the calyx without a re-entrant callosity, crowned by a tuft of woolly hairs which is formed from the ring of woolly hairs projecting from the throat .... 29. *T. stellatum* L.

A. Throat of the calyx with two glabrous, short-haired callosities, without a tuft of woolly hairs.

B. Calyx-lobes 1-nerved or the lower ones 3-nerved at the base, the sinuses broad and rounded.

C. Leaflets linear; flowers in elongated spikes .... 30. *T. angustifolium* L.

C. Leaflets broad; flowers in globular heads or ovoid spikes .... *31. *T. Desvauxii* Boiss.

B. Calyx-lobes 5-7 nerved, with distinct reticulations between, the sinus acute; calyx-tube campanulate .... *32. *T. clypeatum* L.

B. Calyx-lobes 1-3-nerved .... *33. *T. squamosum* L.

Section XII.—CAMPTONEURUM

Scabrous annual; Calyx-lobes spreading in fruit .... 34. *T. scabrum* L.

Section XIII.—MACROBIOTUM

A. Flowers purple; plant stoloniferous .... 35. *T. medium* Huds.

A. Flowers cream-coloured; plant erect .... *36. *T. ochroleucon* Huds.

* These species are not yet naturalised.

THE IDENTIFICATION OF THE SPECIES, BASED ON COMMON CHARACTERS

FOR convenience the clovers can be arranged in six groups according to characteristics common to each.

GROUP A.—THE PERENNIAL CLOVERS

These are plants which live for three or more years. The clovers of the other groups are all annuals, lasting for one season only.

GROUP B.—THE SUBTERRANEAN CLOVER GROUP

The only species of this group which buries its pods in the ground is subterranean clover. The characteristic feature of the group is that the flowers in the flower-head are of two types; an inside (often dense) head of flowers which consist of a solid calyx and no corolla, and an outer series of flowers (usually few) which have both calyx and corolla, and which produce pods.

GROUP C.—THE SUCKLING AND HOP CLOVER GROUP

These annual, often small, clovers have yellow flowers. In all other groups the flowers are purple, red, pink or white. Another characteristic is that, with the single exception of the slender suckling clover, the middle leaflet is on a longer stalk than the two lateral (side) leaflets. This is a useful character in the recognition of the plants before flowering, but does not serve to distinguish them from some of the small trefoils.

GROUP D.—THE BLADDER CLOVERS

In these annual species, the calyx after flowering becomes enlarged and somewhat bladdery. In some, such as shaftal, and woolly clover, the calyx becomes very unequal, the two uppermost teeth being borne on a helmet-shaped upper lip, the three lower remaining unaltered, while in others, such as bladder clover, the calyx remains symmetrical, with five equal teeth. The pod is enclosed in the enlarged calyx.

GROUP E.—THE HAIRLESS CLOVERS

These plants are all annual, with all their flowers perfect, the corolla is never yellow, and the calyx does not become enlarged. The stems, leaves and flowers are quite devoid of hairs.

GROUP F.—THE DOWNY—OR HAIRY—CLOVERS

These are annuals with the characteristics of group E, but the stems and leaves have a covering (loose or dense) of downy, soft, short or long hairs.

GROUP A.—PERENNIAL PLANTS

A. Prostrate creeping plants which root at the joints of the stems.
  B. Flowers white, rarely pale pink, each flower of the head on a distinct slender stalk; veins of the leaflets not, or scarcely branched; leaflets often with a white crescent-shaped mark .... **18. White clover.**
  B. Flowers rose-pink, each flower of the head stalkless, or the stalk obscure; veins of the leaflets branched and usually continued beyond the leaf-edge to form small teeth; flower-heads with an outside cup of brown toothed scales .... **6. Strawberry clover.**

A. Plants erect or the stems soon assuming an erect position, rooting only at the base.
  B. Flowers white (rarely pale pink), each flower on a distinct slender stalk, the stems hollow .... **17. Alsike clover.**
  B. Flowers red or purple without individual stalks, or the stalks very short.
    C. Stipules oblong in shape, the upper free portion triangular and ending in a long fine point; flower-heads not or only shortly stalked; pod opening across (transversely), the upper half falling as a cap .... **24. Red clover.**
    C. Stipules very long and narrow, the free part awl-shaped and spreading; flower-heads distinctly stalked; pod splitting lengthwise .... **35. Zigzag clover.**

GROUP B.—THE SUBTERRANEAN CLOVER GROUP

A. Seed-head burying the pods in the soil or earth debris; inner sterile flowers formed after the development of the outer fertile flowers; calyx of the inner sterile (undeveloped) flowers without any hairs, becoming rigid .... — **1. Subterranean clover.**

A. Seed-head not burying the pods in the soil; inner (sterile) flowers densely hairy with long fine hairs, forming a soft cushion-like mass occupying the centre of the flower-head; sterile flowers formed at the same time as the perfect flowers.

B. Perfect flowers several; stalks of the flower-heads longer than the leaves .... — **2. Globe clover.**

B. Perfect flowers, one or two; stalks of the flower-heads shorter than the leaves .... — **3. Pill clover.**

GROUP C.—THE BLADDER CLOVER GROUP

(All plants devoid of hairs except on the calyx, or entirely without hairs)

A. Calyx when in seed becoming very irregularly swollen, the upper lip formed from the two uppermost calyx-teeth becoming hooded and much longer than the three lower teeth which remain more or less unaltered, densely woolly with matted hairs; flowers purple or pink, the corolla twice as long as the calyx-teeth when in flower.

B. Flowers purple, upper lip of the calyx when in seed becoming conical, with two long bristle-like spreading points .... — **5. Shaftal clover.**

B. Flowers pink; upper lip of the calyx when in seed almost globular, covered with brown wool, with two small down-curved points almost hidden in the brown wool .... — **4. Woolly clover.**

A. Calyx remaining symmetrical after flowering, the tube becoming enlarged and swollen with the teeth equal and spreading. Flower-heads terminal on the stems and branches, entirely without hairs.

B. Calyx quite hairless, with 20 veins .... — **7. Bladder clover.**

B. Calyx with two longitudinal lines of hairs, the tube with about 35 longitudinal veins .... — **8. Dry-headed clover.**

GROUP D.—THE HOP AND SUCKLING CLOVERS

A. Middle leaflet of the three leaflets on a longer stalk than the two lateral leaflets. Heads usually several to many-flowered.

B. Standard (largest petal) narrow towards the base and grooved towards the tip, finally curving downwards over the pod.

C. Stipules broad .... — **9. Trifolium campestre.**

C. Stipules narrow .... — **10. Trifolium aureum.**

B. Standard petal broad at the base, not grooved and remaining erect (not folded forward over the pod) .... — **11. Common suckling clover.**

A. All three leaflets on equal very short stalks; flower-heads 2-6-flowered .... — **12. Slender suckling clover.**

GROUP E.—THE HAIRLESS CLOVERS

A. **The drooping-flowered clovers.** Flowers, especially the upper or inner flowers of the head on long slender individual flower-stalks, so that the flowers droop.

B. Flower-heads one inch or more in diameter on stalks longer than the leaves; calyx-teeth much longer than the hemispherical tube, finely awl-shaped .... — **16. Trifolium balansae**

B. Flower-heads less than an inch in diameter, on stalks shorter than the leaves; calyx-teeth shorter than the tube, lance-shaped .... — **15. Drooping-flowered clover.**

A. **The compact clovers**—the cluster-clover type. Flowers in compact heads, the individual flower-stalks absent, or extremely short.

B. Calyx-teeth about equal.

C. Corolla purplish-pink, longer than the calyx-teeth which are broad and spread when in seed . . . **13. Cluster clover.**

C. Corolla white, shorter than the calyx-teeth which are narrow and finely pointed . . . . . **14. Suffocated clover.**

B. Calyx-teeth very unequal, the lowest triangular and longer than the others which are shorter than the tube, and spine-like and spreading when in seed . . . . . **33. Sea clover.**

GROUP F.—THE HAIRY OR DOWNY CLOVERS

A. Corolla much longer than the calyx, so that the flowers (corollas) are conspicuous in the flower-head.

B. Leaves all alternate; flowers purple-pink . . . . . **31. T. Desvauxii.**

B. Upper leaves opposite.

C. Flower-heads not stalked, the uppermost stipules broad and round, embracing the base of the flower-head . . . . . **19. Rose clover.**

C. Flower-heads stalked.

D. Flowers pink or white.

E. Calyx-teeth very unequal and broad, the lowest five times as long as the other four, with several veins or ribs, recurved when in seed . . . . . **32. Helmet or Oriental clover.**

E. Calyx-teeth ending in bristle-like points.

F. Calyx-teeth unequal, the lowest longer than the others, all without veins . . . . **26. Carmel clover.**

F. Calyx-teeth all more or less equal, 3-veined at the base . . . . . **27. Berseem clover.**

D. Flowers crimson, in elongated spikes . . . . **28. Crimson clover.**

A. Corolla shorter than, or scarcely longer than, the calyx-teeth, so that the flowers are inconspicuous.

B. Stipules broad and obtuse.

C. Flower-heads loose, 1-1½ inches in diameter; stipules below the slender flower-head stalks, toothed in the upper half . . . . . **29. Star clover.**

C. Flower-heads compact, less than half an inch in diameter; uppermost stipules opposite, embracing the greater part of the flower-head; stipules broad at top, not toothed . . . . . **20. Cupped clover.**

B. Stipules tapering into an acute, sometimes a bristle-like point.

C. Leaflets broad or wedge-shaped.

D. Calyx-teeth much longer than the tube, the heads, especially when in seed, with a burr-like appearance.

E. Flower-heads round (globular) . . . . **21. Burr clover.**

E. Flowers in elongated spikes . . . . **25. Ligurian clover.**

D. Calyx-teeth about as long as the calyx-tube, spikes egg-shaped or shortly cylindrical.

E. Calyx-teeth rigid, lance-shaped, spreading when in seed; flowers white; flower-heads not stalked . . . . . **34. Rough clover.**

E. Calyx-teeth awl-shaped, remaining erect when in seed; flowers pink; flower-heads not stalked . . . . . **23. Knotted clover.**

C. Leaflets narrow, much longer than broad.

D. Corolla shorter than the calyx; stems slender and branched, finely hairy . . . . . **22. Hare's foot clover.**

D. Corolla as long as the calyx; stem usually single and unbranched; plant coarsely hairy . . . . **30. Narrow-leaved clover.**

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Berseem clover	27	Pill clover	3
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Burr clover	21	Reversed clover	5
Carmel clover	26	Rose clover	19
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Drooping-flowered clover	15	Slender suckling clover	12
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T. aureum	10	*T. micranthum*	12
T. balansae	16	*T. pilulare*	3
T. campestre	9	*T. pratense*	24
T. Carmelii	26	*T. repens*	18
T. cernuum	15	*T. resupinatum*	5
T. Cherleri	20	*T. scabrum*	34
T. clypeatum	32	*T. spumosum*	7
T. Desvauxii	31	*T. squamosum*	33
T. dubium	11	*T. stellatum*	29
T. fragiferum	6	*T. striatum*	23
T. globosum	2	*T. subterraneum*	1
T. glomeratum	13	*T. suffocatum*	14
T. hirtum	19	*T. tomentosum*	4
T. hybridum	17	*T. xerocephalum*	8
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DESCRIPTIONS OF THE SPECIES

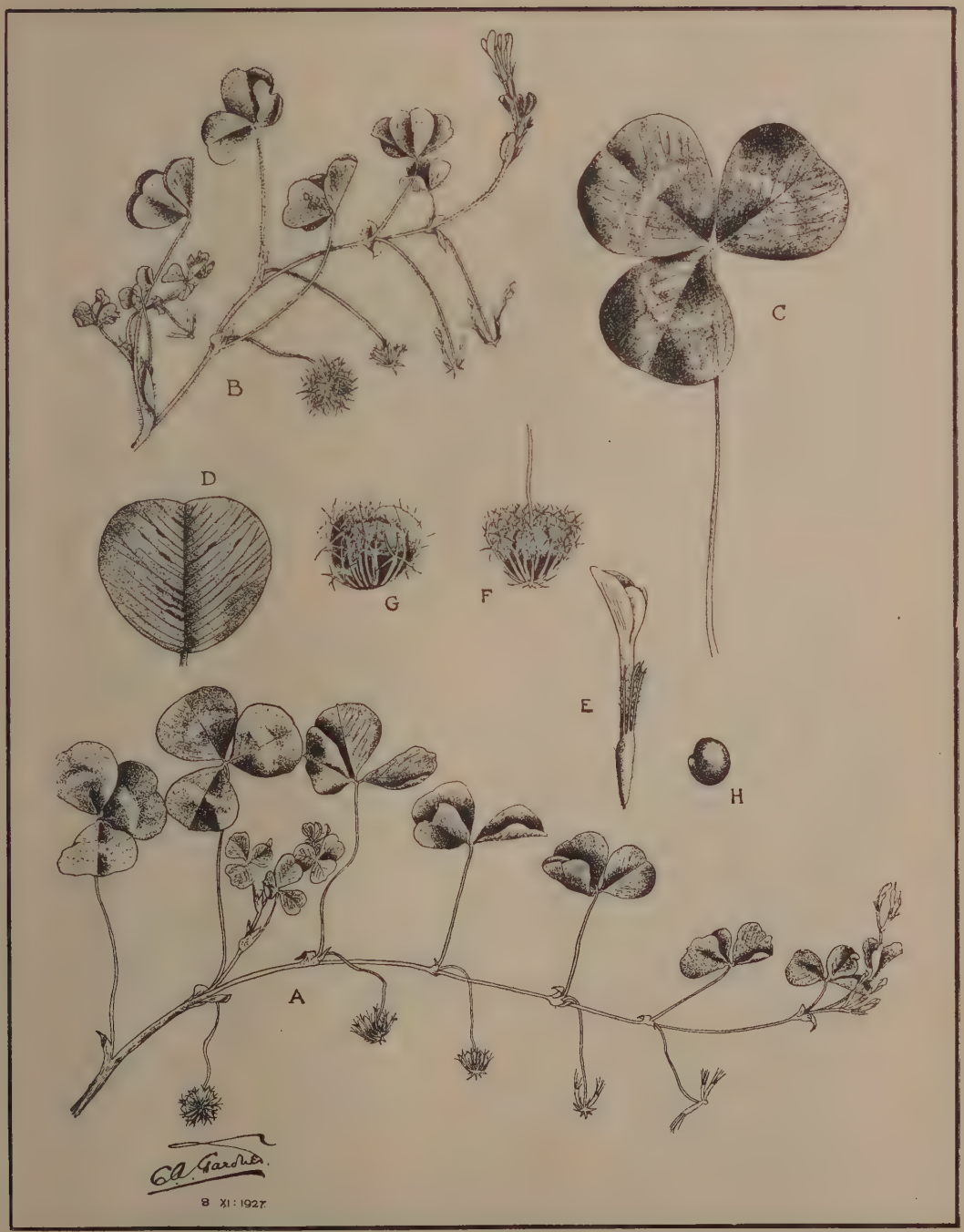
1.—SUBTERRANEAN CLOVER

(*Trifolium subterraneum* L.)

(From the Latin, in reference to its habit of burying its seeds in the soil).

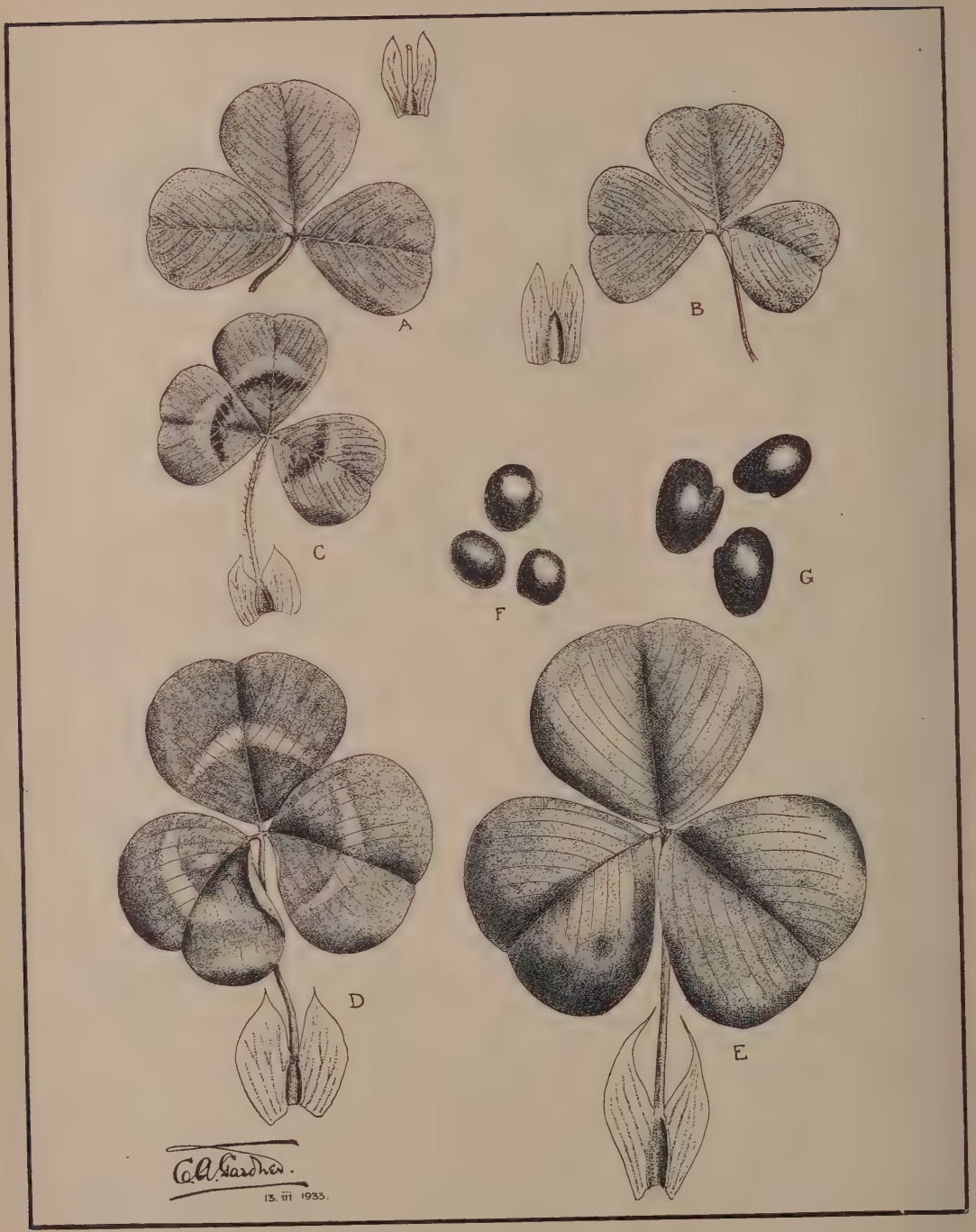
As the name implies, subterranean clover normally buries its seed-pods in the soil, or, if the soil is too hard to allow of penetration, the pods are found among the plant debris on the ground. The mechanism which renders burial possible is found in the centre of the flower-head which consists of a number of infertile flowers of which only the calyx is developed, this being a solid structure with narrow teeth surrounding a central "boss" which has a terminal point. This point assists in burying the seed-head, and the firm calyx-lobes act as anchors in securing the pods in the soil. The number of fertile flowers varies from two to five. The calyx teeth are long and narrow, and fringed with slender hairs. The corolla is white, rarely red or pink often striped with pink. The pods are brown, hard, netted and exserted from the split calyx.

Subterranean clover is native to the Mediterranean region and the Orient.



1.—SUBTERRANEAN CLOVER *(Trifolium subterranean* L.)

A—Habit; B—Stages in floral development; C—Leaf; D—Leaflet; E—Flower; F and G—Seed heads; H—Seed.



1.—SUBTERRANEAN CLOVER *(Trifolium subterranean* L.)

A—Dwalganup strain; B—Daliak strain; C—Northam early strain; D—Mount Barker strain; E—Wenigup strain; F and G—Seeds.

2.—GLOBE CLOVER

(*Trifolium globosum* L.)

(From the Latin *globosus*—spherical or globular).

Globe clover is an annual plant of low, trailing and spreading growth, attaining to a diameter of two or three feet, with hairy stems and leaves. The stalks of the flower-heads are erect and usually longer than the leaves, the leaflets of which vary from egg-shaped to heart-shaped. The stipules are ovate and acute. Like subterranean clover, there are two types of flowers, the outer fertile, the inner sterile and without any corolla. The number of fertile flowers varies from five to about 20 with very narrow, densely hairy, slender teeth, and a pale pink corolla slightly longer than the calyx. The centre of the head consists of a dense mass of sterile flowers, each devoid of a corolla, and having long, almost filamentous, teeth covered with long fine hairs, and forming a soft cushion-like mass. The seed-pods are thin, and included in the calyx. The seeds are not buried in the soil.

Globe clover is native to Greece, Turkey and Asia Minor.

3.—PILL CLOVER

(*Trifolium pilulare* Boiss).

(From the Latin, *pilula*—a globule).

Pill clover has much the same habit of growth as globe clover, and is similarly hairy. The stalks of the flower-heads however, are usually very short, the free part of the stipules is *obtuse*. There are only one or two fertile flowers with a hairy calyx and thread-like hairy teeth, the greater part of the flower-head consisting of numerous sterile flowers represented by a narrow clayx with very long and slender lobes covered by long hairs. The corolla of the fertile flowers is white. The pod, like that of globe clover is membranous and included in the calyx-tube of the fertile flower.

2.—GLOBE CLOVER (*Trifolium globosum* L.)

3.—PILL CLOVER (*Trifolium pilulare* Boiss).

This clover is native to Asia Minor and Syria. It has been received as a naturalised clover from the West Pingelly district.

4.—WOOLLY CLOVER

(*Trifolium tomentosum* L.)

(From the Latin *tomentosus*—woolly).

Woolly clover is an annual plant with spreading stems extending to a diameter of 12 inches or more.

There are no hairs on the stems and leaves which are a bright green in colour. The free part of the stipules is narrow and acute. The stalks of the flower-heads are shorter than the leaves, or sometimes almost absent, and the flowers in the head are practically without stalks. The calyx is little more than half as long as the pale pink corolla; when in fruit it is

4.—WOOLLY CLOVER (*Trifolium tomentosum* Linn.).
A—Plant showing habit; B—Flowering and fruiting heads; C—Flower; D—Pod; E—Seed.

bladdery, pink, turning brown, almost globular, and covered with brown wool. The pods are small and compressed.

Woolly clover takes its name from the woolly seeding heads. It is native to the Mediterranean region, and naturalised in South Western Australia, extending inland to the limits of wheat culture.

5.—SHAFTAL CLOVER OR REVERSED CLOVER
(*Trifolium resupinatum* L.)

(From the Latin *resupinatus*—bent back).

This clover is also known as annual strawberry clover. It is an annual spreading plant quite devoid of hairs except on the calyx. The leaves vary considerably in shape and size, and the free part of the stipules tapers to a fine point. The flower-heads vary from longer than the leaves to much shorter. The flowers are not numerous in the head and are almost stalkless. The calyx is about half as long as the purple corolla, and unequally toothed, the three lower teeth being short and erect., the two upper united and much longer, forming when in fruit a cone-like

5.—SHAFTAL or REVERSED CLOVER (*Trifolium resupinatum* L.).

structure terminating in two fine spreading points, pink in colour, and rather densely woolly-hairy, the fruiting calyx is curved downwards. The pod is small and compressed.

Shaftal clover is fairly common in the Vasse district, as a naturalised plant. It is native to western Europe and the Mediterranean region.

6.—STRAWBERRY CLOVER
(*Trifolium fragiferum* L.)

(From the Latin *fraga*—strawberries).

This plant is a strong-rooted perennial with a partiality for soils rich in lime. It has creeping stems which root at the joints, and is entirely without hairs. The leaflets are relatively small, bright green and with close veins which usually project from the leaf margins in minute teeth. The leaf-stalk is generally elongated. The free part of the stipules is lance-shaped, rather small, and ends in a sharp narrow point. The flower-heads are globular, small, and surrounded at the base by a cup of brown, lacerated bracts. The flowers are on very short stalks. The calyx is less than half as long as the pink corolla, and unequally toothed, the three lower teeth straight and small, the two upper much larger and bent forwards, when in pod forming a netted inflated bladder, the two sharp teeth of the upper lip protruding over those of the lower lip. The pod is small, egg-shaped, and enclosed in the inflated calyx.

The common name is due to the semblance of the fruiting head to a strawberry. The species is widely distributed throughout Britain, Europe and the Mediterranean region, extending eastwards to the Himalaya.

7.—BLADDER CLOVER
(*Trifolium spumosum* L.)

(From the Latin, *spumosus*—foamy or full of foam).

An annual plant with erect or spreading ribbed stems, entirely destitute of hairs. Leaflets obovate, toothed. Free part of the stipules is ovate, of a chaffy consistence, tapering into a long fine point. Flower-heads at the ends of the stems, globular when in flower, elongating in fruit to ellipsoidal and one and a half inches long by one and a quarter inches broad., with rather large bracts below each flower, the flowers rather large, pink in colour. Calyx 20-nerved, the nerves or veins very prominent with the addition

6.—STRAWBERRY CLOVER (*Trifolium fragiferum* L.).

A—Habit; B—Leaf; C—Leaflet; D—Flower head; E—Flower; F—Fruiting head; G—Fruiting calyx and seed.

7.—BLADDER CLOVER (*Trifolium spumosum* L.).

of numerous transverse nerves between and connecting them, very shortly stalked, enlarging and becoming bladder-like when in pod, with rather fine equal spreading or recurved teeth, the tube much narrowed at the top. Corolla much longer than the calyx.

The plant is native to the Mediterranean region. It is not yet naturalised, but under experimental cultivation shows some promise as a pasture species. The large bracts under the individual flowers are finely lined, and characteristic of this plant.

8.—DRY-HEADED CLOVER

(*Trifolium xerocephalum* Fenzl.)

(From the Greek, *xeros*—dry and *kephale*—a head).

An annual plant almost entirely without hairs, the stems spreading or creeping. Leaflets oblong to broadly obovate, with finely toothed margins and usually a small short terminal point. The free part of the stipules has long fine points. Flower-heads at the ends of the stems and its branches, each flower with a bract at the base, the heads globular, less than an inch in diameter, densely flowered, elongated in fruit. Calyx inflated in fruit, somewhat pear-shaped, with numerous (about 36) nerves or veins, and marked by two hairy longitudinal lines, the lobes equal. Flowers purple.

Native to Asia Minor and Syria. Under experimental cultivation this plant shows some promise under local conditions.

9.—HOP CLOVER

(*Trifolium campestre* Schreb.) (*T. agrarium* L, and *T. procumbens* L.)

(From the Latin, *campestris*—growing in fields).

An annual plant with creeping or ascending stems, sparingly downy. Leaflets obovate to oblong-rhomboidal, obtuse, sometimes notched. The free part of the stipules is ovate, tapering at the end. Stalks of the flower-heads as long as or longer than the leaves. Flower-heads egg-shaped, dense, less than half an inch in diameter, each flower distinctly stalked. Calyx teeth unequal, the upper ones triangular, the three lower narrower, all longer than the tube. Corolla yellow, the standard broad and rounded.

Native to Europe. A common naturalised species.

10.—HOP CLOVER

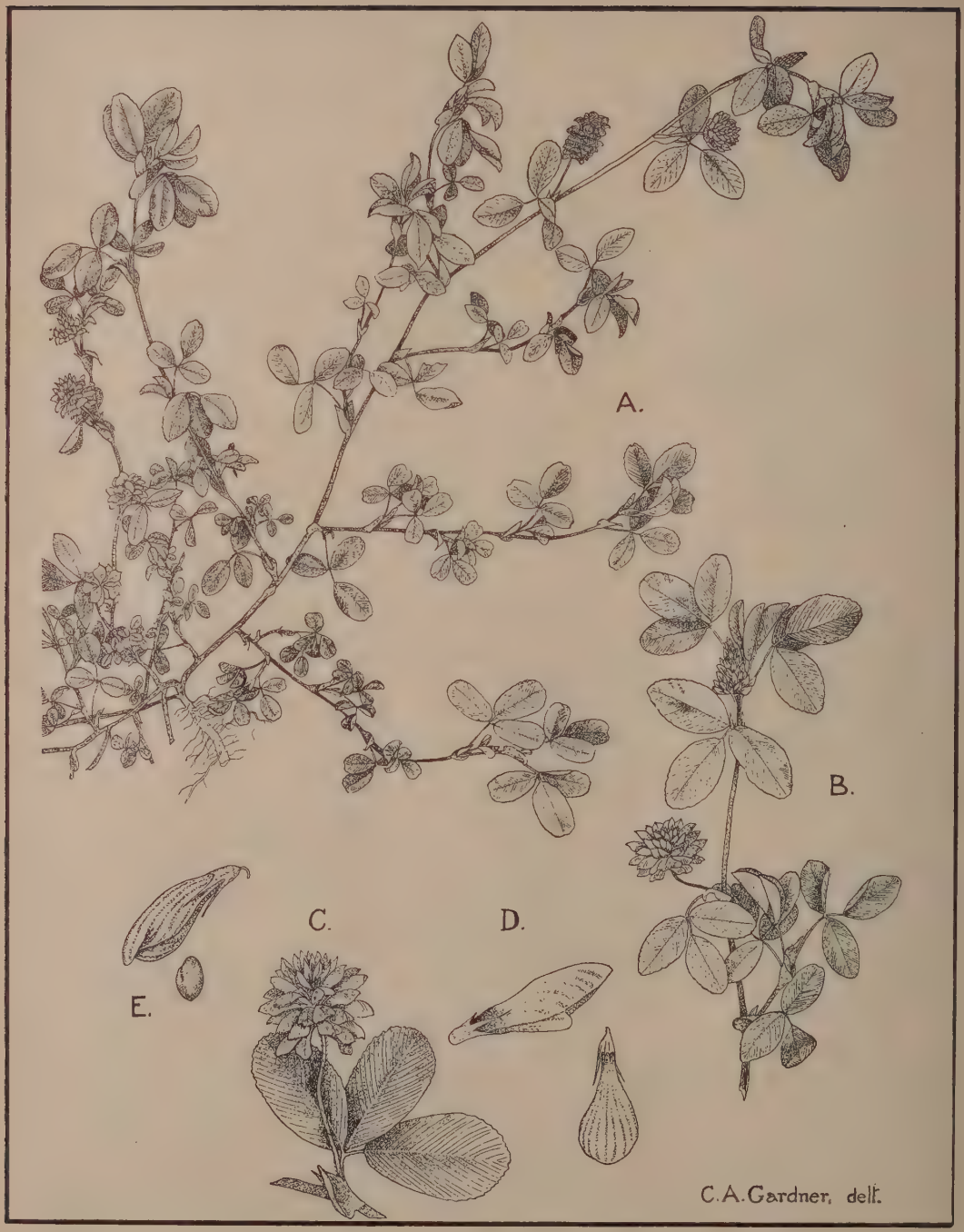
(*Trifolium aureum* Poll.) (*T. agrarium* auct.)

(From the Latin, *aureus*—golden).

An annual plant with erect or trailing stems, slightly downy. Leaves with the terminal leaflet situated some distance above the two lateral leaflets, all small, the common leaf-stalk short. Free part of the stipules very narrow, tapering into a fine point. Flower heads globular, arising from the axils of the leaves, usually with seven or eight flowers in the head which is rarely half an inch in length on stalks longer than the leaves, the corolla much longer than the calyx.

This plant has much the aspect of *T. campestre*, but is larger, and can be distinguished by the longer corolla.

Native to Europe, from Norway to Spain and eastwards to Russia and Asia Minor.



9.—HOP CLOVER *(Trifolium campestre* Schreb.).

A and B—Habit; C—Leaf and flower head; D—Flower; E—Mature flower and seed.

11.—SUCKLING CLOVER
(*Trifolium dubium* Sibth.) (*T. minus* Sm.)

(From the Latin, *dubius*—doubtful, of uncertain affinity).

A slender annual which lies close to the ground, more or less hairy, spreading to a diameter of from 12 to 18 inches. Leaflets small, narrowed at the base, the terminal leaflet situated some distance above the two lateral leaflets; free part of the stipules broadly ovate, tapering into a fine point. Flower heads on stalks arising from the leaf-axils, and longer than the leaves, 4-20-flowered, very small (about a quarter of an inch in diameter), the corolla yellow, turning a dark brown in fruit, the standard narrow. Calyx-lobes triangular.

Native to Europe and the Caucasus, and southwards to Palestine.

11.—SUCKLING CLOVER (*Trifolium dubium* Sibth) (*T. minus* Sm.)

12.—SLENDER SUCKLING CLOVER
(*Trifolium micranthum* Viv.) (*T. filiforme* auct.)

(From the Greek, *mikros*—small, and *anthos*—flower).

A small, slender, hairless annual with small leaves on very short stalks, the leaflets all stalkless, almost wedge-shaped and toothed at the apex; the free part of the stipules oblong and acute. Flower-heads on slender stalks as long as or longer than the leaves, two- to six-flowered, the individual flowers on slender stalks as long as or longer than the calyx-tube, the calyx teeth very narrow, about as long as the tube; corolla yellow, very small, the standard broad and notched.

Native to Europe and the Caucasus.

13.—CLUSTER CLOVER
(*Trifolium glomeratum* L.)

(From the Latin, *glomeratus*—collected into heads).

A small, slender, spreading annual plant totally, or almost quite without hairs, the stems trailing or spreading. Leaflets less than half an inch long; free part of the stipules ovate to lance-shaped, tapering into a long fine point. Flower heads about half an inch in diameter, globular, without a common stalk, mostly in the axils of the leaves. Calyx-tube without hairs, the teeth ovate, rigid, spreading and often reflexed after flowering, becoming rigid and spine-like. Corolla much longer than the calyx, purplish or pink, the standard folded over the other petals.

Native to Europe and the Mediterranean region, extending eastwards to Syria and Palestine.

13.—CLUSTER CLOVER (*Trifolium glomeratum* L.).

14.—SUFFOCATED CLOVER
(*Trifolium suffocatum* L.)

(From the Latin, *suffocatio*—suffocation).

Suffocated clover is typically a small tufted annual with shortly creeping stems seldom more than three or four inches in length, the whole plant without hairs. Leaflets more or less wedge-shaped and notched, with prominent spreading nerves or veins. The small flowers are in dense heads without a common stalk, and at the ends of the branches as well as in the axils of the leaves. The calyx is relatively narrow and thin, with narrow acute teeth about as long as the narrow tube. The corolla is white, and shorter than the calyx-teeth.

Southern Europe and the Caucasus; also naturalised in, or native to, Britain. Fairly common on the western coastal plain in South Western Australia.

14.—SUFFOCATED CLOVER (*Trifolium suffocatum* L.).

15.—DROOPING FLOWERED CLOVER
(*Trifolium cernuum* Brot.)

(From the Latin, *cernuus*—falling with the face downwards).

A prostrate annual, the stems spreading to a diameter of two feet or more, the whole plant devoid of any hairs. Leaves on long stalks, the leaflets obovate-cuneate, toothed, strongly nerved; free part of the stipules with a broad base tapering into a long fine point. Flower-heads loose, on stalks usually about as long as or shorter than the head, the flowers on distinct slender stalks nearly as long as the calyx, and usually recurved. Calyx-tube rather narrow, the lobes lance-shaped, slightly shorter than the calyx-tube and tapering into fine points. Corolla pink, slightly longer than the calyx. Pod 2-3-seeded, the seeds yellow.

Native to Southern France and Spain, naturalised and cultivated in South-Western Australia, common in moist depressions as far east as Meckering and Pingelly.

16.—*TRIFOLIUM BALANSAE* BOISS.
(Derivation unknown).

This clover appears to have no common name. It is an erect or diffuse annual, quite without hairs, and with elongated hollow ribbed stems with the leaves at rather long intervals. The leaflets are narrow and distinctly toothed in the upper part, and the free part of the stipules tapers from a broad somewhat toothed base. The flower-heads are large, often one and a half inches in diameter, with numerous flowers each on a distinct slender stalk, those of the upper or inner part of the head on longer stalks than the lower. The calyx-teeth are awl-shaped and somewhat longer than the bell-shaped smooth, 10-nerved tube. The corolla is pale pink or white, and more than twice as long as the calyx—half to three-quarters of an inch long.

Native to Asia Minor, cultivated at Denmark, and apparently showing some promise.

17.—ALSIKE CLOVER
(*Trifolium hybridum* L.)

(From the Latin, *hybrida*—a mongrel, supposedly a hybrid).

An erect or spreading annual, often more than 18 inches tall, with hollow stems. Leaflets large, elliptical in outline, on stalks up to four inches in length; free part of the stipules oblong, terminating in a fine point. Flower-heads in the axils of the leaves, globular, often more than an inch in diameter, on stalks about three inches long. Flowers, especially the upper ones, on slender stalks longer than the calyx-

15.—DROOPING-FLOWERED CLOVER *(Trifolium cernuum* Brot.).

A—Habit; B—Leaf; C and D—Flower heads; E and F—Flowers; G—Seeds.

tube, the teeth of the calyx awl-shaped and somewhat longer than the tube. Corolla twice as long as the calyx, white or sometimes pale pink.

Native to the Mediterranean region and the Caucasus.

16.—*Trifolium balansae Boiss.*

18.—WHITE CLOVER
(Trifolium repens L.)

(From the Latin, *repens*—creeping).

Also sometimes known as "Dutch clover." A creeping perennial entirely devoid of hairs, the prostrate stems rooting at intervals, and spreading to a diameter of over three feet. Leaflets obovate or almost heart-shaped, usually with a white angled band towards the base, the stalks up to six inches in length, but sometimes very short; free part of the stipules oblong with a short narrow point. Flower-heads globular, on stalks arising from the leaf axils, the flowers, especially the upper on slender stalks. Calyx with lance-shaped lobes, somewhat unequal, the two upper about as long as the tube. Corolla white, twice as long as the calyx.

Common in the northern temperate regions of the Old World.

19.—ROSE CLOVER
(*Trifolium hirtum* All.)

(From the Latin, *hirtus*—hairy).

An annual plant with hairy erect or spreading stems. Leaflets wedge-shaped, the free part of the stipules membrane-like, ovate to lance-shaped and terminating in a fine hair-like point. Flower-heads globular, stalkless, sheathed at the base by the uppermost dilated stipules. Calyx half as long as the corolla, with equal bristle-like teeth which are twice as long as the tube. Corolla purple, twice as long as the calyx.

The plant is native to the Mediterranean region and Asia Minor, but is under experimental cultivation locally, and showing some promise.

20—CUPPED CLOVER
(*Trifolium Cherleri* L.)

(From a personal name).

Annual, with prostrate stems, the stems ascending, hairy with rather dense, soft hairs. Leaflets wedge-shaped, toothed; free part of the stipules round, shortly pointed. Flower-heads globular, stalkless and sheathed at the base by the round, often leafless stipules. Calyx softly hairy, the teeth equal, bristle-like, twice as long as the tube. Corolla white or pale purple, slightly longer than the calyx.

Native to the Mediterranean region, Syria and Palestine.

21.—BURR CLOVER
(Trifolium lappaceum L.)

(From the Latin, *lappaceus*—burr-like).

An annual plant with erect stems, the whole plant sparingly hairy with hairs lying close to the stems and leaves. Free part of the stipules narrow, lance-shaped and finely pointed, the leaflets narrow to somewhat heart-shaped. Flower-heads globular, with stalks, or stalkless between the uppermost opposite stipules. Calyx

17.—ALSIKE CLOVER *(Trifolium hybridum* L.).

A—Habit; B—Leaf; C—Flower; D—Pod; E—Seed.

tube 20-nerved, with equal bristle-like teeth more than twice as long as the hairless tube. Corolla pink, only slightly longer than the calyx-teeth.

Native to the Mediterranean Region, Syria and Palestine.

22.—HARE'S FOOT CLOVER
(Trifolium arvense L.)

(From the Latin, *arvensis*—applied to plants of arable land).

An annual, with slender erect branched stems. Stems and leaves are clothed with fine, rather long, spreading grey hairs. Leaflets narrow, elliptical-oblong, toothed in the upper part, the free part of the stipules narrow and ending in a fine point. Flowers in egg-shaped or oblong terminal stalked spikes which become cylindrical when in fruit. Calyx-tube hairy, 10-nerved, the teeth bristle-like, two or three times as long as the tube, becoming hard in fruit. Corolla pale pink, shorter than the calyx-teeth.

Native to Europe, Asia, North Africa and the Orient. A common weed in South-Western Australia. The flower-spikes have a characteristic lavender colour.

23.—KNOTTED CLOVER *(Trifolium striatum* L.)

23.—KNOTTED CLOVER
(Trifolium striatum L.)

(From the Latin, *striatus*—marked with longitudinal lines or ridges).

Annual, the stems prostrate to almost erect, softly hairy throughout. Leaflets obovate, slightly toothed. Free part of the stipules ovate to triangular, with long fine points. Flower-heads terminal and in the axils of the leaves, without any common stalk, sheathed at the base by the dilated stipules, becoming oblong or conical in fruit. Calyx hairy, strongly 10-ribbed, especially when in fruit, the teeth broadly awl-shaped, rigid, shorter than the tube, erect when in flower, but spreading and spine-like when in fruit. Corolla pale pink, about as long as the calyx-teeth, the standard folded over the lower petals.

Native to Southern Europe and Asia Minor.

24.—RED CLOVER
(Trifolium pratense L.)

(From the Latin, *pratensis*—of, or relating to, a meadow).

A perennial plant with erect or ascending stems, up to two feet in height, downy-hairy. Leaflets oblong or obovate, often notched, and frequently with a white crescentic spot near the base, the leaf-stalk long. Free part of the stipules triangular with a long fine point. Flower-heads terminal, stalkless, globular or ovoid, large (above an inch in diameter). Calyx-tube ribbed, hairy, with four short bristly teeth and one (the lowest) about twice as long, erect in flower, and spreading when in fruit. Corolla pink-purple or rarely whitish, longer than the calyx, the standard notched.

Native to Europe and temperate Asia.

18.—WHITE CLOVER *(Trifolium repens* L.).
A—Habit; B—Flower; C—Flower head.

19.—ROSE CLOVER *(Trifolium hirtum* All.).

21.—BURR CLOVER *(Trifolium lappaceum* L.).

20.—CUPPED CLOVER *(Trifolium Cherleri* L.).

22.—HARE'S FOOT *(Trifolium arvense* L.).

24.—RED CLOVER *(Trifolium pratense* **L.).**
A—Habit; B and C—Flowers; D—Pod; E—Seeds.

25.—LIGURIAN CLOVER (*Trifolium Ligusticum* Balb.).

25.—LIGURIAN CLOVER
(*Trifolium Ligusticum* Balb.)

(From Latin, *Ligusticus*—applied to Liguria, the modern Piedmont).

Annual, the stems erect or loosely spreading, softly hairy. Leaflets obovate. Free part of stipules lance-shaped, tapering into a fine terminal point. Flower-heads egg-shaped or cylindrical, usually two together, one stalked, the other without a stalk. Calyx with equal bristle-like erect teeth from a rather broad triangular base, twice as long as the tube and longer than the pink corolla.

Native to Mediterranean region, Syria and Palestine.

26.—CARMEL CLOVER
(*Trifolium Carmelii* Boiss.)

(From Mt. Carmel in Palestine).

Annual, with hollow ascending forked stem; is clothed throughout with hairs lying close against the surface. Upper leaves opposite. Leaflets elliptical to oblong, the upper ones acute. Free part of the stipules lance-shaped, tapering into a fine point. Flower-heads on long stalks, egg-shaped when in flower, oblong when in fruit. Calyx-teeth thickened at the base bristle-like, hairy, unequal, the four upper teeth not twice as long as the tube, the lowest one and a half times as long. Corolla creamy-white, twice as long as the calyx.

Native to Syria and Palestine.

27.—BERSEEM CLOVER
(*Trifolium Alexandrinum* L.)

(From Alexandria, the Egyptian City founded by Alexander the Great).

Annual, sparsely hairy with hairs lying close to the surface, the stems erect and branched. Leaflets ovate-elliptical. Free part of the stipules lance-shaped, ending in a fine point. Flower-head terminal, stalked, egg-shaped, becoming conical in fruit. Calyx with lance-shaped teeth produced into bristles, nearly equal, three-nerved at the base, erect in flower, spreading in fruit, about as long as the calyx-tube. Corolla creamy-white, twice as long as the calyx.

Native to Egypt, Asia Minor, Syria and Palestine.

28.—CRIMSON CLOVER
(*Trifolium incarnatum* L.)

(From the Latin, *incarnatus*—flesh-coloured).

Annual, stiffly hairy, the stems erect, 15 to 18 inches tall. Leaflets on long stalks, broadly obovate. Free part of the stipules ovate and obtuse. Flowers in ovoid to cylindrical spikes up to two inches long or more. Calyx-tube densely hairy, the teeth bristle-like, half as long again as the tube, erect when in flower, spreading in fruit. Corolla crimson, longer than the calyx.

Native to the Mediterranean region and France.

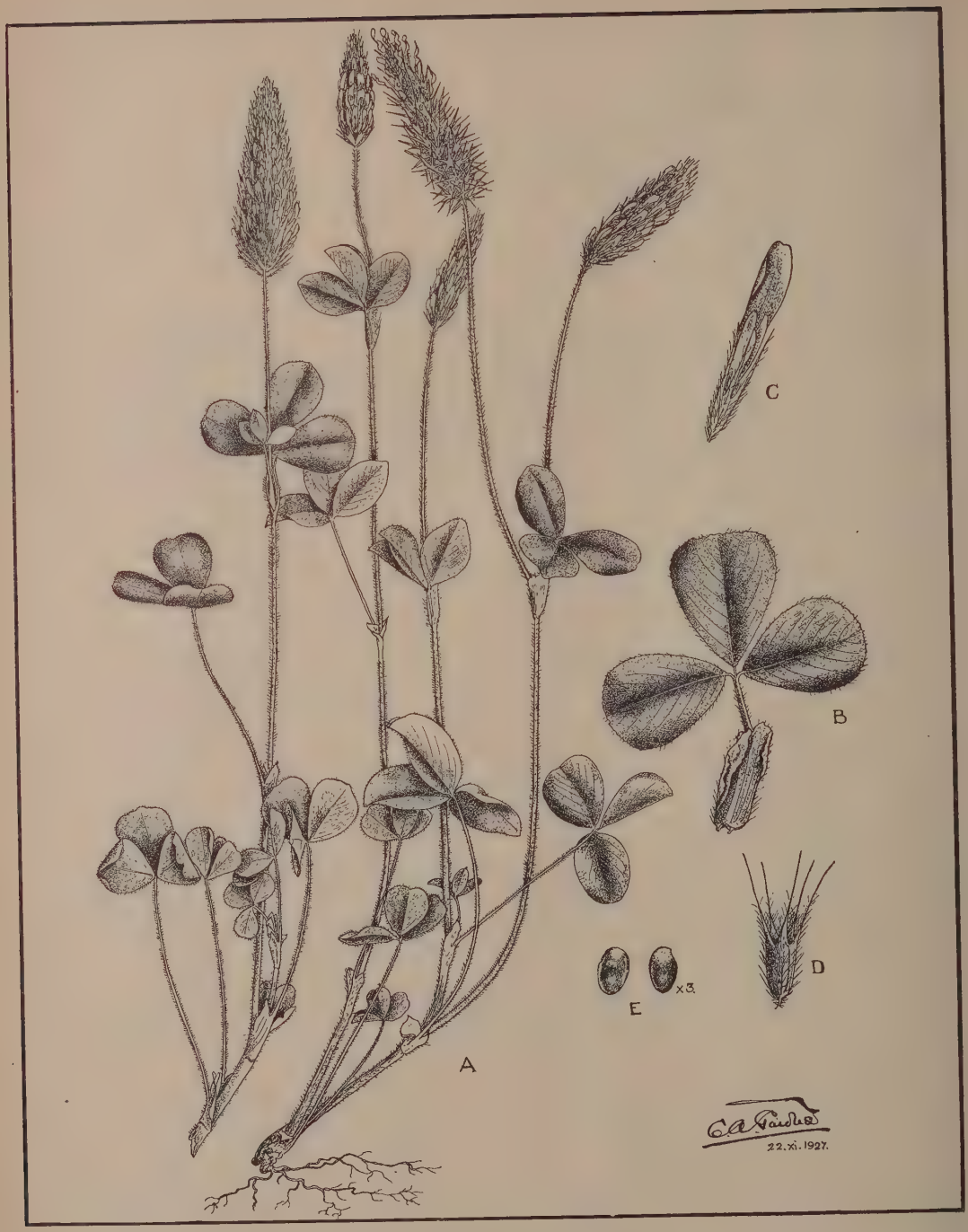
29.—STAR CLOVER
(*Trifolium stellatum* L.)

(From the Latin, *stellatus*—set with stars, in allusion to the star-shaped fruiting calyx).

Annual, with softly hairy stems and leaves, the stems erect or ascending. Leaflets small, almost wedge-shaped to heart-

27.—BERSEEM CLOVER *(Trifolium Alexandrinum* L.).

A—Habit; B—Leaf; C—Flower head; D—Flower; E—Seed.



28.—CRIMSON CLOVER (*Trifolium incarnatum* L.).

A—Habit; B—Leaf; C—Flower; D—Calyx; E—Seeds.

29.—STAR CLOVER (*Trifolium stellatum* L.).

shaped. Free part of stipules ovate and obtuse, very rarely acute, toothed in the upper part. Flower-heads terminal, on long stalks, globular, loose, the flowers on short slender, distinct stalks, and together with the calyx invested with rather long spreading hairs. Calyx-teeth lance-shaped, produced upwards into a long fine point, about three times as long as the bell-shaped calyx-tube. Corolla white or pink, about as long as the calyx-teeth.

Native to the Mediterranean region and Asia Minor, Syria and Palestine.

30.—NARROW-LEAVED CLOVER
(*Trifolium angustifolium* L.)

(From the Latin, *angustus*—narrow, and *folium*—leaf).

An erect annual, with ribbed stems, hairy with close-lying hairs on the stems and leaflets. Leaflets long and narrow, up to two inches long. Free part of the stipules bristle-like. Flowers in oblong to cylindrical terminal spikes up to three and a half inches long. Calyx-tube with somewhat unequal awl-like teeth about as long as the tube, erect in flower, spreading in fruit, shorter than the pink corolla.

Native to the Mediterranean region and the Orient. A weed.

31.—*TRIFOLIUM DESVAUXII* BOISS.
(A personal name).

An annual plant, with alternate leaves; leaflets narrowly elliptical, or linear, obtuse. Free part of the stipules awl-shaped. Flower-heads stalkless or shortly-stalked, egg-shaped to conical. Calyx-tube 10-nerved, the teeth awl-shaped, hairy, the lowest being the longest. Corolla purplish-pink.

Native to Syria.

32.—HELMET CLOVER or ORIENTAL CLOVER
(*Trifolium clypeatum* L.)

(From the Latin, *clypeus*—a round shield or buckler).

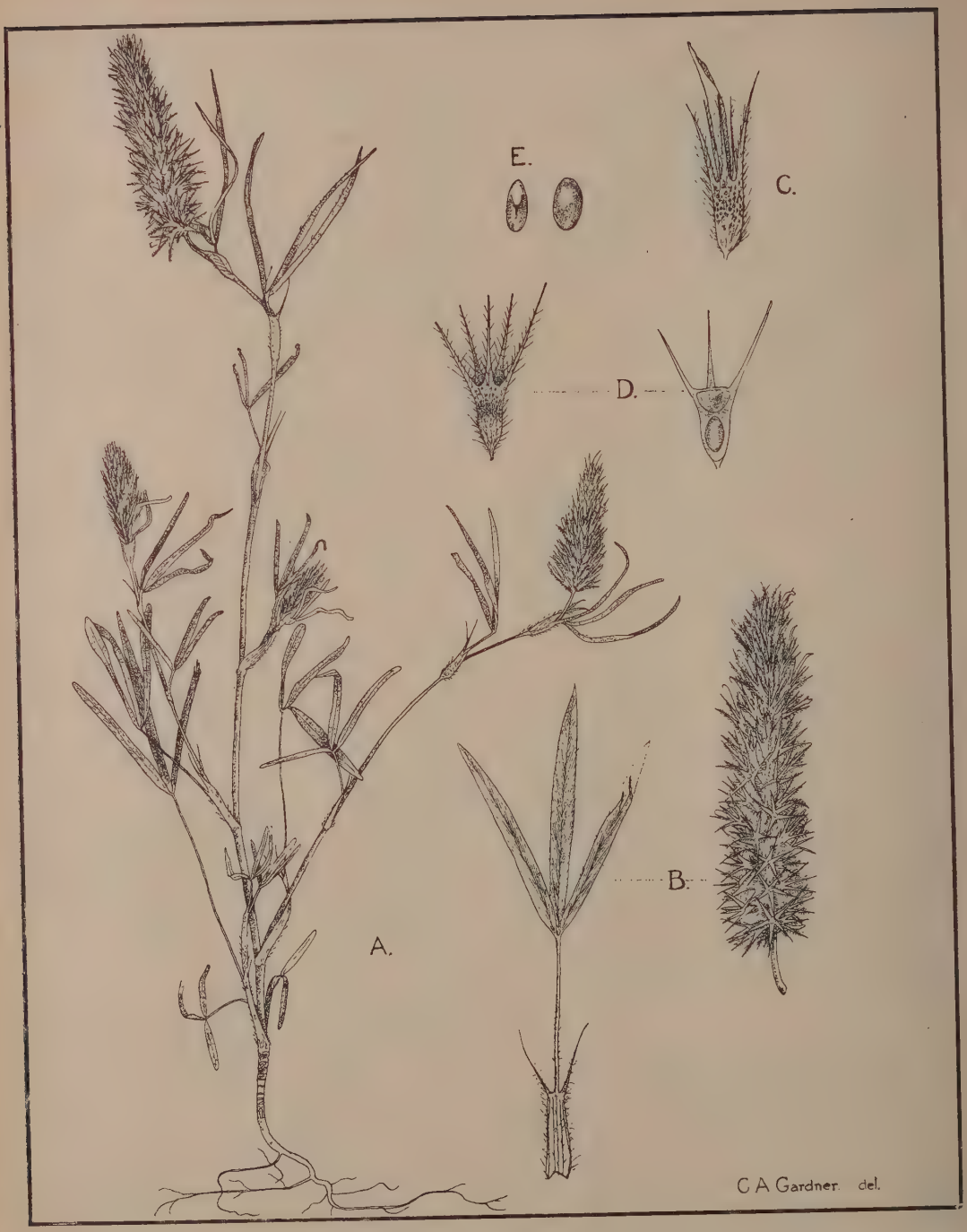
A low spreading annual plant, sparsely and loosely hairy. Upper leaves opposite. Leaflets large, obovate, shortly pointed or notched at the apex. Free part of the stipules dilated, half-ovate and acute. Flower-heads on long stalks, egg-shaped and broadest above the middle, somewhat compact. Calyx with flat leaf-like lance-shaped teeth, the lowest one about five times as long as the other four. Corolla pink, much longer than the calyx. Calyx-teeth strongly reflexed in fruit.

Native to Greece and Asia Minor.

33.—SEA CLOVER
(*Trifolium squamosum* L.) (T. *maritimum* Huds.)

(From the Latin, *squamosus*—scaly or scale-like).

An annual plant sparingly hairy, or almost completely without hairs, the stems erect or ascending, branched. Leaflets wedge-shaped, obtuse or shortly pointed. Free part of the stipules narrow and acute. Flower-heads not stalked, subtended by the uppermost pair of leaves. Calyx-tube bell-shaped, the teeth broadly awl-shaped,



30.—NARROW-LEAVED CLOVER *(Trifolium angustifolium* L.).

A—Habit; B—Leaf and flower head; C—Flower; D—Calyx and section of calyx; E—Seeds.

32.—HELMET CLOVER *(Trifolium clypeatum* L.).

three-nerved, rigid, the lowest triangular and longer than the others which are shorter than the tube, all spine-like and spreading when in fruit. Corolla pale pink, slightly longer than the calyx.

Native to Western and Southern Europe.

34.—ROUGH CLOVER
(*Trifolium scabrum* L.)

(From the Latin, *scaber*—rough, in allusion to the clothing of rough hairs).

Erect, or spreading annual, up to eight inches tall. Leaflets obovate, small, shortly pointed, downy-hairy on both surfaces. Free part of the stipules triangular, shortly tapering into a sharp point. Flower-heads terminal and axillary, stalkless, egg-shaped. Calyx-tube 10-ribbed, hairy, almost cylindrical, the teeth triangular, becoming rigid and spreading in fruit with sharp points as long as, or longer, than the calyx-tube.) Corolla white, shorter than the calyx.

Native to Europe and Western Asia.

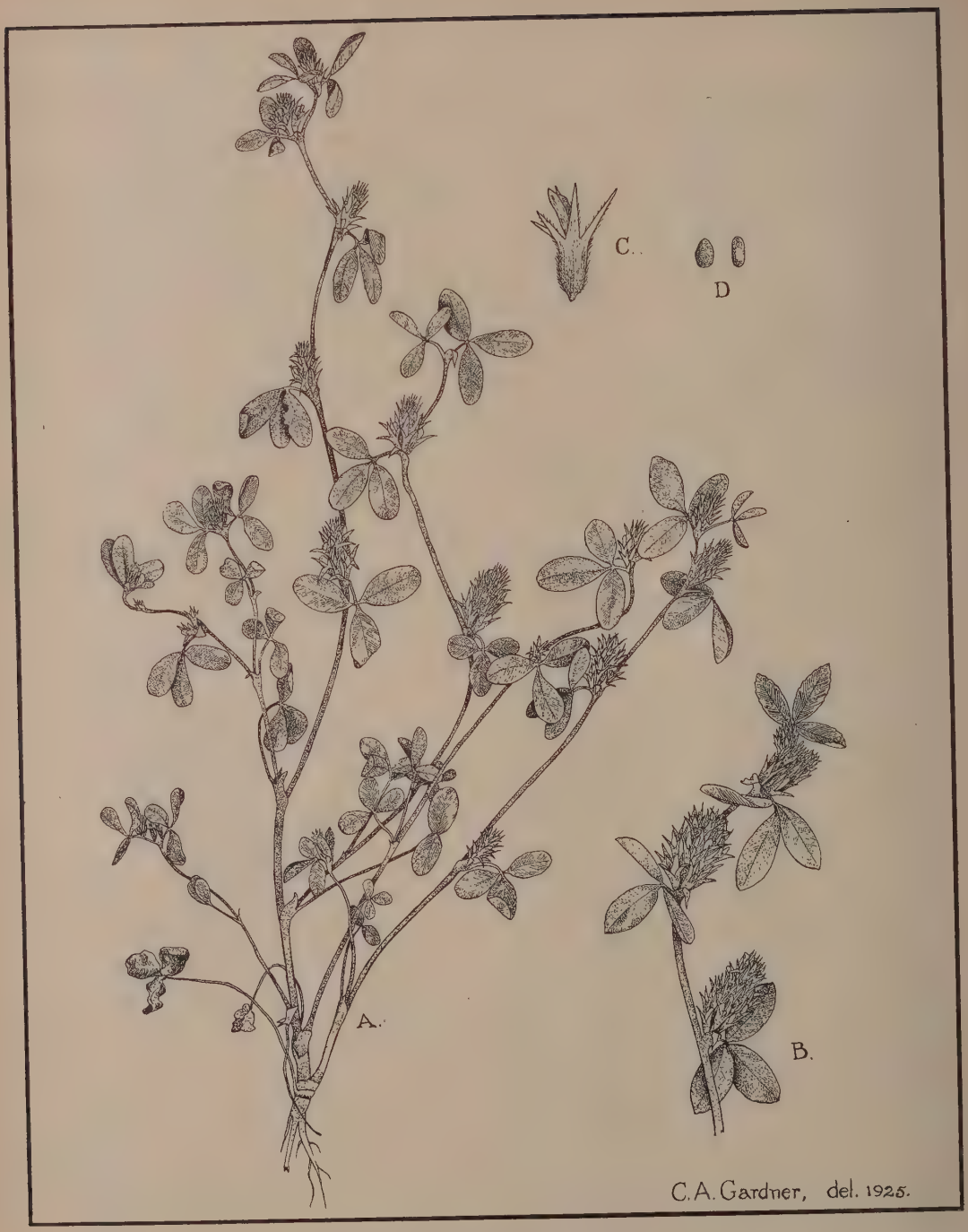
35.—ZIGZAG CLOVER or MAMMOTH CLOVER
(*Trifolium medium* Huds.)

(From the Latin, *medium*—the middle, intermediate or ordinary).

A perennial plant with flexuous almost zigzag stems up to 16 inches tall, almost devoid of hairs. Leaflets rather large, narrowly oblong to elliptical, fringed with fine hairs, often with a faint whitish spot near the base. Free part of the stipules awl-shaped and spreading. Flower-heads terminating the branches, large, globular, on short stalks, with a pair of leaves below. Calyx-tube bell-shaped, faintly ribbed, hairless, the teeth awl-shaped, spreading in fruit. Corolla reddish-purple, two or three times as long as the calyx.

Native to Europe and Siberia. With the general aspect of red clover, this species can be distinguished by its narrow awl-shaped stipules, shortly stalked flower-heads and the pods which open longitudinally—not transversely.

34.—ROUGH CLOVER *(Trifolium scabrum* L.).



34.—ROUGH CLOVER *(Trifolium scabrum* L.).

A—Habit; B—Leaves and flower heads; C—Flower; D—Seeds.

Fig. 1.—The Muresk homestead built by Andrew Dempster in 1899. It houses the College dining room, recreation room and administrative offices

MURESK AGRICULTURAL COLLEGE

By W. SOUTHERN, B.Sc. (Agric.), Dip.Ed., Principal

WHEN the West Australian Government established Muresk Agricultural College in 1926, it added a new chapter to an interesting story of land settlement and utilisation which had its origin in the early years of the Swan River Colony. Much of the present College land was included in a 4,400-acre grant made to Henry Reveley in 1838, but portions of the grant were forfeited in the same year and taken up by Du Bois Agett, the property then being known as Down Farm.

To Down Farm in 1856 came Matthew Oliver with his bride. It was he who planted the large pepper-tree which still stands in front of the West Domitory. Old records indicate that wheat was grown on Down Farm, a popular variety being Clubhead. Although no superphosphate was used, yields of from nine to 26 bushels to the acre were obtained over long periods.

Large quantities of sandalwood provided settlers with a means of augmenting their incomes. This fragrant wood was in keen demand in China, where it was used in the manufacture of joss-sticks, and many dray-loads were carted to Perth for export. The son of Matthew Oliver remembers journeying to Perth in a dray drawn by a horse and a bullock yoked in tandem.

For some years prior to 1890, Down Farm had been owned by Andrew Dempster, one of the sons of Captain James McLean Dempster, master of a schooner trading between Australia and Mauritius in the 1830's. Captain Dempster became a farmer on the Bucklands Estate at Irishtown near Northam and his sons maintained the family's amphibious traditions by establishing a sheep station at Esperance and annually captaining the sailing ship which took their wool-clip to Adelaide and returned with stores.

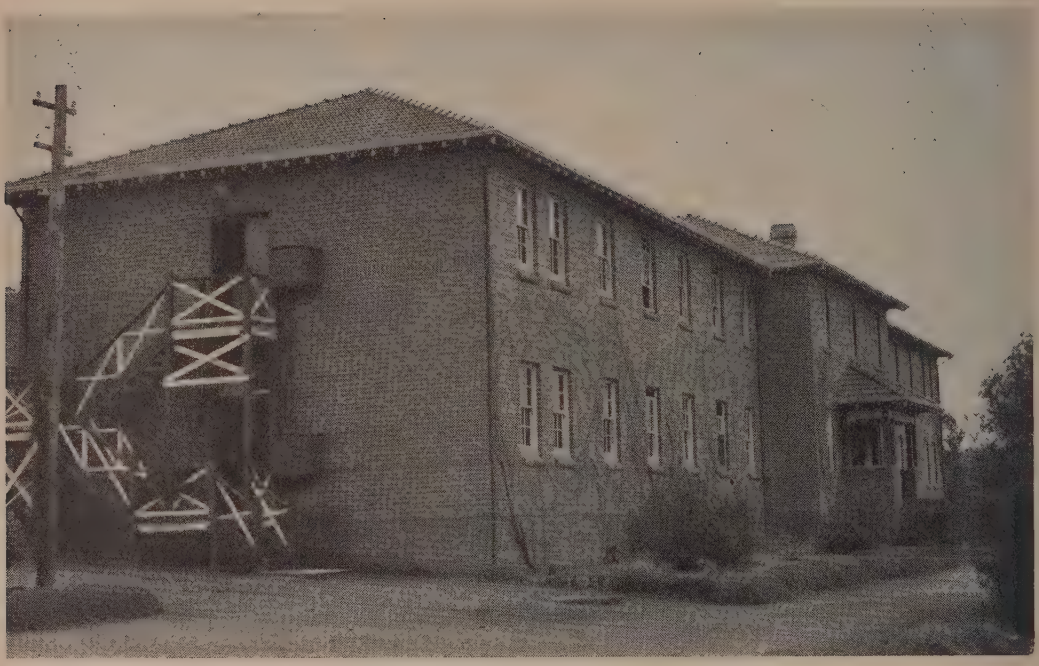


Fig. 2.—One of the two dormitory blocks

In 1887, Mrs. Andrew Dempster became seriously ill at Esperance. With his sick wife, his eldest daughter and two blackfellows, Andrew Dempster set off in a buggy and, with only a small compass to aid him, travelled 600 miles across trackless and virtually unknown country to Northam in order to obtain medical advice. The trip took about three weeks and was accomplished in almost incessant rain. Such a magnificent piece of bushmanship deserved a happy ending but unfortunately Mrs. Dempster died after an operation had been performed.

Perhaps it was this bereavement which influenced Andrew Dempster to take up his abode at Down Farm which had been rented to a man named Smith. In 1899 he built the magnificent homestead which now contains the College dining-room, kitchen and administrative block, and in the following year he renamed the property Muresk after the Dempster's family estate on the River Esk in Scotland.

Andrew Dempster died in 1909 and the portion of the estate on which the homestead stands passed into the possession of his daughter, Mrs. E. W. Cotton. Mr. and Mrs. Cotton lived at Muresk until its purchase by the State Government in 1925.

MANY ADVANTAGES

The College lands are 2,222 acres in area and are located between Northam and York, nine miles from the former and 15 miles from the latter township. Situated as it is on the verge of the wheatbelt, Muresk has an assured rainfall and its location permits of practical instruction being given in cereal-growing, dairying, fruit-growing and the production of root and forage crops.

The property is located in excellent stock country and affords opportunities for students to receive instruction and practical experience in most branches of animal husbandry.

The College buildings are on rising ground commanding a noble view of the Avon Valley. The Avon River flows through the property, adding to its beauty and affording the students facilities for swimming.

Fig. 3.—The Muresk science block containing laboratories and lecture rooms

The surrounding country is undulating and well-wooded and the average elevation of the property is 600ft. above sea level, an altitude which makes the location a particularly healthy site.

Being only 64 miles from Perth, the College is readily accessible by road or rail, which facilitates the close association between it and the Department of Agriculture.

Muresk is similar in standard to other Australian agricultural colleges, such as Dookie, Gatton, Hawkesbury, Longerenong, Roseworthy and Wagga, and has already made worthwhile contributions to tertiary education in our State.

Its aims are:—

(1) To train students in the science of agriculture and farming practices, and at the same time to provide opportunities for continuing with some aspects of general education.

(2) To raise the general standard of efficiency in farming by holding short courses of instruction for farmers.

(3) To carry out research work.

(4) To raise the standard of stock in farming areas by breeding and distributing pure-bred stock.

Wheat, oats, barley and peas are grown on the College lands and, in accordance with the rotation which obtains at the College, certain of the paddocks are laid down to pasture, principally subterranean clover and Wimmera ryegrass. To provide green feed in summer for the dairy herd, pigs and poultry, a plot has been laid down under irrigation.

For instructional purposes, the College has an orchard, vineyard, vegetable garden and apiary.

The Muresk dairy herd consists of pedigreed Guernsey cattle and is noted as being one of the finest herds of that breed in Australia. Pig herds of improved Berkshire and Tamworth have been founded on foundation stock imported from Great Britain, New Zealand and elsewhere and these are two of the leading pig studs in the State.

The College sheep flock consists of Merino ewes run as a commercial flock. Border Leicester x Merino ewes are also

bred from these for mating with British breeds in connection with the raising of fat lambs for export and the local market.

In the poultry section the main breeds are the Australorp, White Leghorn and Rhode Island Red.

A complete building scheme has been laid down for the College and subsequent additions will conform generally to this plan. The present College buildings consist of two dormitories, a science block, lecture rooms, a domestic block, and residences for members of the staff. In the dormitories each student has a separate room and in the bathrooms hot and cold showers are installed.

A large common-room, a library and reading rooms and a dark-room are set apart for the use of students. Radios have been installed.

The science blocks contain laboratories and lecture rooms. An up-to-date gas plant is in use in the laboratories. A carpenter's workshop and engineering workshop are provided in which technical instruction is given to the students.

The College is linked with the S.E.C. mains which supply light and power for the buildings, and for its water supply the establishment is connected to the Goldfields Water Scheme. The septic tank system has been adopted for the treatment of sewage.

ADMISSION STANDARD

A selection is made each year after the Junior Certificate results are known. The successful applicants then continue with secondary school studies for another year. Some prefer to do still another year and take the Leaving Certificate before starting the Muresk Course.

Preliminary knowledge of agricultural science, as a subject, is not necessary. It is much more desirable that applicants have basic knowledge of science and other subjects; and consequently the subjects which must be studied prior to selection are:—

(1) **At Junior Certificate Standard.**

English, Mathematics (Arithmetic and Algebra), Mathematics (Geometry and Trigonometry), Physics, Chemistry, Book-keeping.

Other subjects are optional but it is suggested that Geography be one of them.

(2) **At Sub-Leaving Standard.**

English, Mathematics A, Physics (including Heat, Magnetism and Electricity), Chemistry and others.

Some applicants find it convenient to take Junior Standard Book-keeping in the Sub-Leaving Year.

When Chemistry and Physics cannot be taken at the applicant's school, General Science can be substituted but the student must attend a High School (or other school which is prepared to supply the necessary tuition) for special sub-leaving courses in Physics and Chemistry, in order that the necessary standard can be attained.

APPLICATIONS

The completed application should reach the College by December 31, of the year that the student takes the Junior Certificate.

A selection is made as soon as the Junior Certificate results are known. Those chosen are certain of a place in 13 months' time provided they perform a satisfactory Sub-Leaving year in the meantime.

Examples.—A student chosen at the end of 1957 enters Muresk in 1959 provided his 1958 report is satisfactory. A place will be reserved for 1960 admission if he wishes to take the Leaving Certificate in 1959, again provided that satisfactory progress has been made.

Any vacancies which exist after the preliminary selections are filled, in order of receipt, by qualified applicants.

Each application must include:—

(a) Completed application forms (forms supplied on request).

(b) Headmaster's testimonial.

(c) Another testimonial.

(d) Medical certificate of general fitness.

(e) Applicant's own statement as to his interests, future intentions, etc.

(f) Scholarship applications—if such are being made (forms supplied on request).

THE DIPLOMA IN AGRICULTURE COURSE (M.D.A.)

The course is one of two years' duration. A large number of subjects are covered including English, Farm Management and Economics, Agriculture, Animal Husbandry, Chemistry, Engineering, Bookkeeping, Veterinary Science, Woolclassing, Surveying, etc.

Students are engaged in practical work on the various farm sections, every alternate week.

First-year students have to remain for further practical experience during four weeks of the summer vacation. Second-year students remain for two weeks during the winter vacation.

Lectures and demonstrations are given to the students in the lecture-room and laboratories. Records are kept by the students of all work performed and a farm dairy course covers routine work on the farm.

Excursions are arranged to places of agricultural interest, and in addition to theoretical and laboratory work, students must cover the full range of practical work. They take part in all field operations on the farm and work in the engineering and carpenters' shops. Their training covers the handling of tractors, various implements and different types of machinery.

Each student is given practical instruction in building construction and mechanical work and in turn they spend time in the dairy, piggery, poultry sheds, orchards, vineyard and garden. They also gain practical experience in the breeding and management of stock, and work in the sheep yards and woolshed.

FEES, SCHOLARSHIPS, ETC.

The fees charged are very low—in accordance with Government policy—and are approximately £100 per annum.

Several scholarships for Muresk are available and awarded each year and the selection of applicants is made at the end of the year and immediately prior to the year of entry to the College.

Education Department scholarships and allowances may be continued at the College and the "living away from home" allowance of £50 per annum is available to students entitled to it.

The McCaughey Bequest and the Canteens Service Fund's assistance apply to Muresk College students who come within the provisions of the scheme.

GENERAL

The College year is divided into two terms of 20 weeks each; the first term begins late in February and ends early in July and the second term commences in August and concludes at Christmas.

Students have the advantages of a residential college and facilities are provided for sports. General recreation committees are elected for the control of cricket, football, tennis, swimming, atheletics, rifle shooting, gymnastics, etc. The annual sports meeting is held just prior to the Royal Show and a swimming carnival is held annually in the attractive college pool.

For indoor recreation there are two reading rooms, piano and radios, a billiard table, table tennis outfits and a technical and fiction library provides literature to meet the needs of the students.

Hobbies such as photography are encouraged and facilities are provided. The College has a cinematograph with a sound track and films are shown frequently.

The College conducts its own savings bank agency, book store, tuckshop and post office.

The majority of the students are farmers' sons who return to the family farms but there are many other avenues of employment open to Muresk graduates. Those with good academic qualifications my proceed to the University in order to study for the degree in agriculture, or in veterinary science.

The College is a sub-department of the Department of Agriculture and copies of the College prospectus may be secured from the Principal, Muresk Agricultural College, Muresk, W.A., or the Department of Agriculture, St. George's Terrace, Perth.

FARMERS' WINTER COURSES

During the winter vacation (four weeks in July-August) two short courses for farmers are conducted. The subjects of

the courses vary from year to year and details are announced in the press and on the radio.

Students go into residence at the College for three or four days and the chosen topics are thoroughly discussed and illustrated by demonstrators, the showing of suitable films and slides together with lectures and practical field work.

Intending applicants are advised to apply early as accommodation at the College is limited and each year many applicants have to be refused admission on this account. A nominal fee is charged.

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SAFFRON THISTLE

Carthamus lanatus (Tourn.) L.

Saffron Thistle, or Star Thistle as it is sometimes called in this State, is native to the Mediterranean region and Western Asia. It was recorded as a bad weed in South Australia in 1887 and is now a problem in many cereal growing and pastoral districts in the Southern States. Although favouring heavy soils it is not entirely restricted to them.

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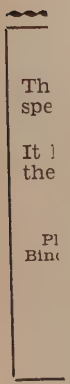


WEEDS of Western Australia

By **G.R.W. MEADLY** M. Sc.
Officer in Charge, Weeds and Seeds Branch

SAFFRON THISTLE

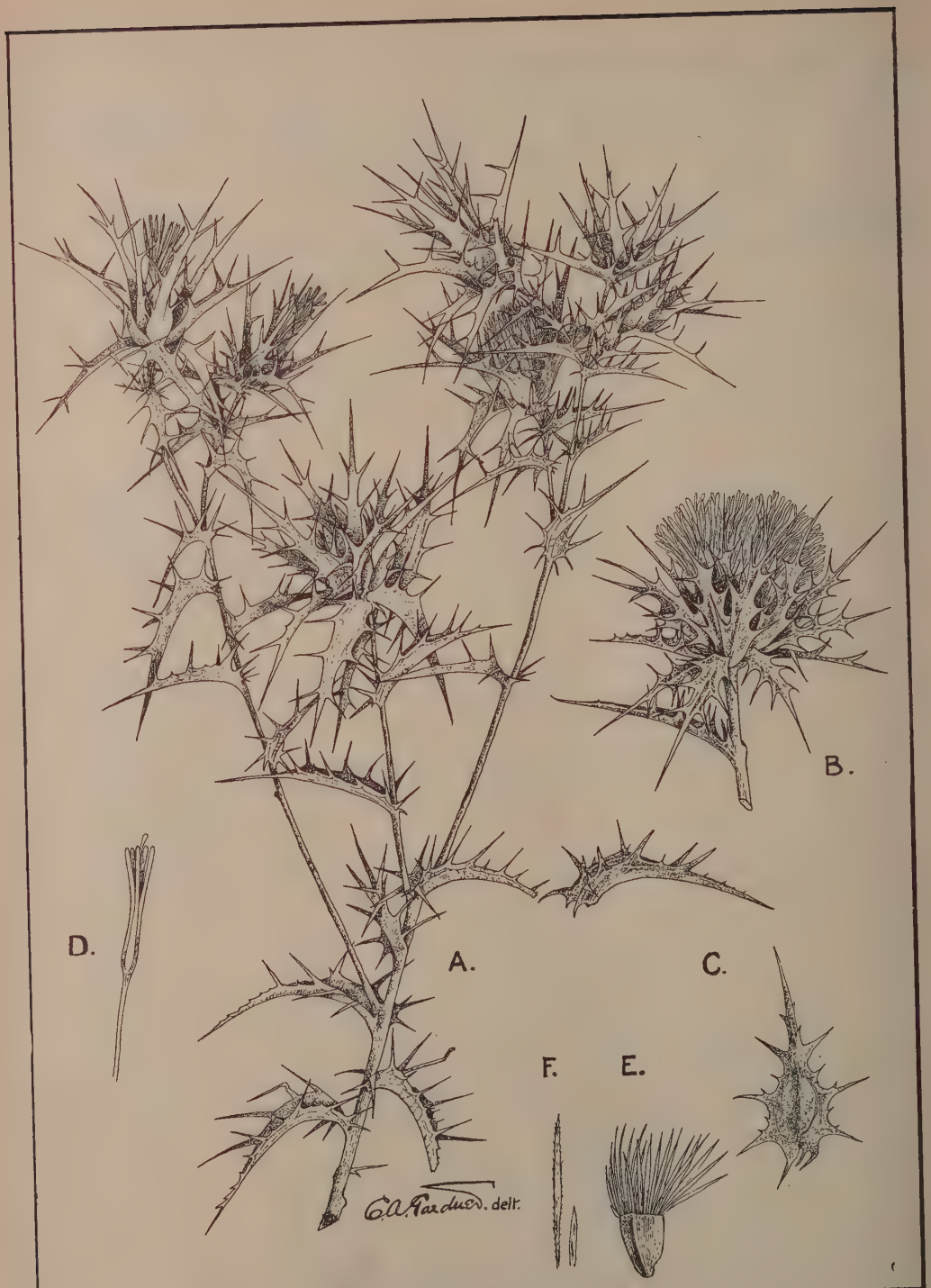
(*Carthamus lanatus* (Tourn.) L.)

REFERENCE has been made in other articles of this series to the confusion that may arise from several different vernacular names being applied to one plant. The weed frequently called Star Thistle in Western Australia is known as Saffron Thistle in most other places where it grows, and the name Star Thistle is applied to a different plant. Although difficult to alter well established usage it is desirable that Carthamus lanatus be called Saffron Thistle. This name has already been accepted in many districts and will be used in this article.

Saffron Thistle is native to the Mediterranean region and Western Asia but has become established in many countries and now occurs in all Australian States. The time and place of the first entry to Australia is not recorded but it was listed as a bad weed in South Australia in 1887 when legislation was passed in an attempt to cope with it.

Saffron Thistle is now widespread in New South Wales, Victoria and South Australia and is thoroughly established in a number of districts in this State. It has been recorded from places as far apart as Northampton, Meekatharra, Busselton, Salmon Gums and the Eastern Goldfields and occurs over thousands of acres within these limits. In some districts the in-

Fig. 1.—Saffron thistle growing on heavy soil at York



SAFFRON THISTLE
(*Carthamus lanatus* (Tourn.) L.)

A.—Flowering stem; B.—Head of flowers; C.—Leaf; D.—Upper portion of single flower; E.—Seed; F.—Seed scales.
(From a pen-drawing by C. A. Gardner, Government Botanist.)

festations are small, but in others, the weed is thoroughly established over extensive areas. It favours the heavier soils but is not entirely restricted to them.

DESCRIPTION

"Saffron" has been borrowed from the related species *Carthamus tinctorius*, the safflower of India and China, from which red and yellow colouring materials have been obtained along with a useful oil.

The plant is an annual with erect, rigid stems, two to seven feet in height, distinctly streaked with raised lines. The upper portions and branchlets are somewhat webby and woolly, at least when young. The leaves are short, rigid and spreading, bright green, prominently veined and spiny toothed. The lower leaves are shortly stalked while the upper ones clasp the stem. The single flower heads are surrounded by spreading leaves. The numerous florets comprising the flower head are intensely yellow. The grayish achenes ("seeds") somewhat resemble a shuttle-cock. A four-angled base about one-eighth of an inch long is surmounted by a fringe of semi-transparent scales.

SIGNIFICANCE

Sheep will eat the young plants if more attractive herbage is not available. The mature spiny plants, however, are seldom grazed, in fact often prevent stock from gaining access to useful forage. Cases of ulcerated mouths have occurred when animals have decided to try this harsh diet, while the sharp spines of the leaves have caused lameness by penetrating the hoofs.

A dense growth of Saffron Thistle reduces the carrying capacity of pastures and also causes a substantial reduction in the yield of crops, besides adding to the difficulties of harvesting. Cereal grain containing Saffron Thistle seeds is docked when delivered to the bulk bin.

The importance of controlling Saffron Thistle in a wheat crop is underlined by yields obtained last season at Manilla in New South Wales. Of 500 acres on one property 200 acres were sprayed with 2,4-D. This area produced 12 bags to the acre. The remaining 300 acres, similar to the sprayed crop in the soil type and yield potential, produced only seven bags to the acre and this wheat was not accepted at the silo because of the amount of Saffron Thistle it contained. Although not producing a burr such as Bathurst burr, the spiny seed-heads become entangled in wool and can be very troublesome.

Saffron Thistle is a declared primary noxious weed.

CONTROL

The spread of Saffron Thistle in Western Australia has been due, in the main, to the distribution of hay, chaff and grain containing seeds of the weed. Stock and machinery have also been responsible for its introduction to some districts. Any farm produce brought to a property should be examined for the presence of seeds of important weeds such as Saffron Thistle.

Being an annual, prevention of seeding is the primary consideration when planning control measures. It is important to remember that seeds will mature if plants are cut at the flowering stage without being destroyed. There is sufficient sap in the cut stems to allow a proportion of the immature seeds to develop fully.

Control is made more difficult by the fact that seeds may germinate over an extended period in any one season. The initial germination occurs in the autumn but some further emergence can be expected later, particularly if the soil is moist when temperatures commence to rise in the spring. The seeds also retain their viability for long periods in much the same way as wild radish. Clean paddocks have become reinfested as a result of ploughing bringing seeds to the surface and providing favourable conditions for germination. These characteristics of seed dormancy and an extended germination period accentuate the need for thorough and systematic control measures when dealing with Saffron Thistle.

The most practical method depends largely on the extent of the weed and the conditions under which it is growing. Cultivation, burning, cutting and spraying have all been used to advantage and often a combination of methods is the most satisfactory. There is a tendency to ex-

Fig. 2.—A growth of Saffron thistle on limestone soil near the South Fremantle power station

pect chemicals to solve our weed problems but in most cases, cultural methods remain the first line of attack and this applies in the case of Saffron Thistle.

When only isolated plants occur, they should be pulled or grubbed before flowering. If the flowering stage has been reached, the plants should be bagged and burnt, taking care not to distribute seeds.

Extensive and heavy infestations on arable land should be burnt, if possible, and ploughed as soon as practicable, after the germination of the weed in the autumn. The fallow should be kept clean by means of sheep, supplemented by harrowing when necessary. The area should be cultivated the following autumn, and seeding delayed as long as possible to allow plants resulting from the first germination to be destroyed. By sowing a crop for hay and cutting early, further thistles are cut before they set seed. The paddock can then be grazed and isolated plants destroyed by hand.

Besides destroying some of the seeds along with the trash, burning often facilitates other control measures. In some seasons it can be timed to prevent later plants from reaching maturity. This is possible when the other herbage will carry a fire before the thistles have formed seed.

Good results have been obtained by cutting, either with an orthodox mower or a rotary chain slasher. The terrain must permit close cutting and the operation must be timed carefully. If carried out too early, mature seeds may be formed on the regrowth, while late cutting may not prevent seed formation.

Although not as susceptible as wild radish and wild turnip, Saffron Thistle can be controlled by spraying with the growth regulating or 2,4-D herbicides. When the plants are at the young rosette stage—about two inches across—the application of 8 oz. acid equivalent per acre of 2,4-D ester or 12 oz. 2,4-D amine has been effective without being too severe on established pasture. When the plants have formed a rosette four to six inches in diameter at least 1 lb. acid equivalent of 2,4-D ester is usually necessary. With larger plants, especially when the flowering stem has appeared, 1½ lb. acid equivalent per acre of 2,4-D ester is recommended and this should be increased to 2 lb. when the plants are nearing the flowering stage. Low volume application using 6 to 8 gallons of solution per acre has been as effective as spot spraying with 100 gallons per acre using a knapsack or wand from a power unit. Heavy grazing before treatment is desirable and further grazing later is also an advantage.

Experimental work carried out at Ballidu showed that Saffron Thistle is somewhat more susceptible to chemicals when growing in a cereal crop. When sprayed at the appropriate growth stage of both crop and weed, good control has been obtained with 8 oz. acid equivalent of 2,4-D ester per acre or 12 oz. of 2,4-D amine.

With our experimental work these rates of application have not affected the yield of cereals when applied at the "safe" stage i.e. when the plants are stooling and six to eight inches high.

Aerial spraying has also been undertaken both on grazing land and land under wheat. With this method of application increased rates are advisable and, based on our experience to date, 10 to 12 oz. acid equivalent of 2,4-D ester per acre is necessary when the weed is growing in a crop. In the case of grazing land, when the thistle is at the large rosette stage, this rate should be doubled. Clovers and trefoils are affected by the treatment.

Spraying is often delayed in order to locate the areas more readily and to ensure that maximum seedling emergence has taken place. We must keep in mind, however, that older plants are much more difficult to kill. In some cases they have recovered and set seed when sprayed at an advanced growth stage.

It is essential that control measures against Saffron Thistle should be planned in advance, as any programme, to be effective, must be carried on for several years. The control of this weed is most difficult on pastoral country where often large areas are involved and for various reasons, cultivation is seldom carried out. Eradication of Saffron Thistle in Western Australia is scarcely practicable but much can be done to reduce its effect on production. The present objective is to eradicate it from districts where the infestations are limited and make every effort to confine it in those agricultural areas where it is thoroughly established.

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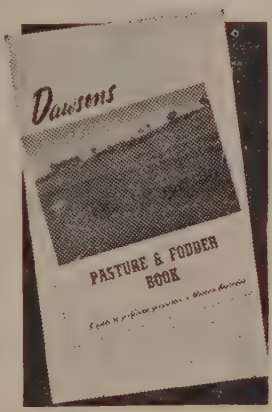

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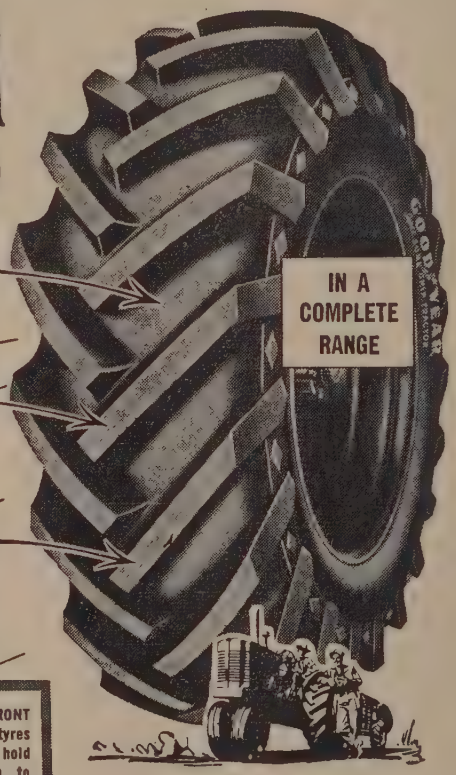

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The DEHORNING of CATTLE

By J. SHILKIN, B.V.Sc.,
Senior Veterinary Surgeon

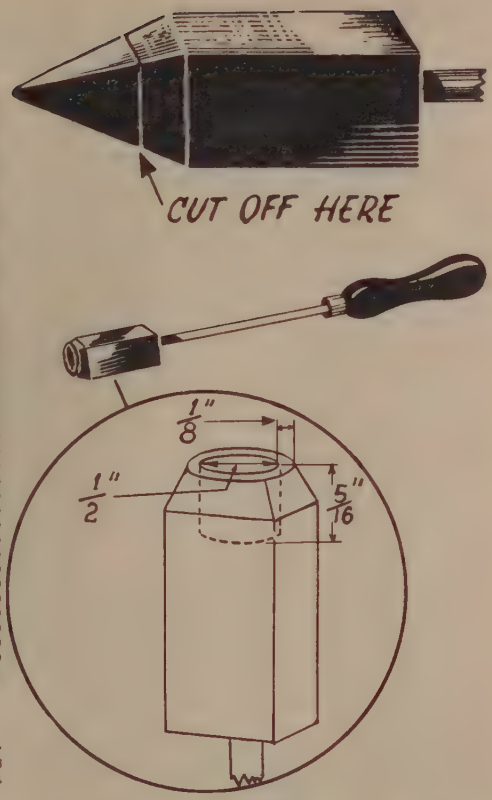

Fig. 1.—Making a disbudding instrument from a soldering-iron. A portion of the tip is cut away, the corners are removed by filing and a half-inch hole is drilled in the centre

HORNS on domesticated cattle serve no useful purpose and are responsible for losses which, in the aggregate, amount to many thousands of pounds every year. Horn-caused bruises lead to reduced prices for beef carcasses, and many cases of mastitis in dairy herds have their origin in udder injuries resulting from horn-prods. In addition, the fear inspired by horned "boss cows" leads to lowered milk production from their more timid herd-mates, while the possession of horns adds to the risks of handling the herd bulls.

When the ancestors of our domesticated cattle existed in a wild state, their horns were a means of defence against predatory animals. They were also the means by which the bulls established their superiority over rival contenders for herd leadership.

Now that they are no longer needed for offensive or defensive action, horns are superfluous and their removal has so many advantages that dehorning should be adopted as a routine practice.

Dehorning brings a marked change in herd behaviour as many dairy-farmers can testify. The cattle are easier to handle and may be closely concentrated in holding yards, or when strip-grazing with the aid of an electric fence. Even the most aggressive members of the herd tend to become placid, and there are corresponding benefits in increased production and reduced losses from mastitis.

OPPOSITION

Among stud-breeders, there is some understandable opposition to dehorning. Some studmen maintain that the appearance of show cattle is marred by the removal of the horns—that a dehorned animal might suffer when being judged beside horned members of the breed. Despite this fear, there are many well-known studs which dehorn all animals in calf-hood as a routine practice.

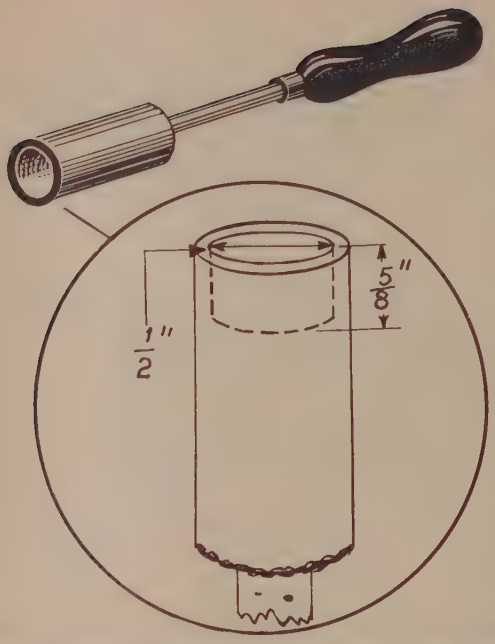

Fig. 2.—Copper or steel tubing made into a disbudding instrument

In reality, an increasing number of show judges are taking the sensible view of dehorning and in any case the points score allowed for the horns is usually small. As for appearance—after all, we have been breeding polled cattle for many years and the absence of horns does not make an Aberdeen-Angus or a Red Poll any less pleasing to the eye.

Other objections to dehorning are based on humanitarian grounds. Some pain is undoubtedly caused, whatever method is used to remove or prevent the growth of the horns, but this can be reduced to a minimum by efficient operations.

In any case the transient pain of dehorning cannot be compared with the lasting pain of serious injuries caused by horned animals in aggressive mood.

Undoubtedly, the most humane and most effective method of dehorning is to treat the animals at an early age to prevent the growth of the horns.

DEHORNING OF CALVES

Calves should preferably be treated during their first ten days of life but in beef herds where mustering is infrequent, more horn growth will occur and surgical treatment may be carried out up to the age of three months.

Chemical Treatment.

The destruction of the horn-producing cells by chemical means has many advantages but should be applied when the calves are not more than 10 to 14 days old.

The best preparation is:—

	Per Cent.
Antimony trichloride	28
Salicylic Acid	7
Flexible Collodion	65

Have the mixture prepared by a chemist and keep it in a glass-stoppered bottle as it solidifies on exposure to the air.

The hair should be clipped from an area about two inches in diameter surrounding each horn bud and the area should then be cleaned thoroughly with methylated spirit and lightly rubbed with steel wool to produce an abrasion of the skin.

The chemical mixture is then applied with a brush and worked well in to ensure contact with the skin. The collodion soon forms a closely-adhering film.

Caustic soda or caustic potash sticks are often used for dehorning calves, but have some disadvantages when compared with the collodion mixture.

Clipping of the hair surrounding the bud is carried out as previously described and then a ring of vaseline is smeared round the horn bud—but not on it. The vaseline helps to restrict the spread of the chemical to the horn bud and a narrow strip of skin surrounding it.

One end of the caustic stick should be in a holder, wrapped in paper, or held in a rubber glove to protect the fingers. The

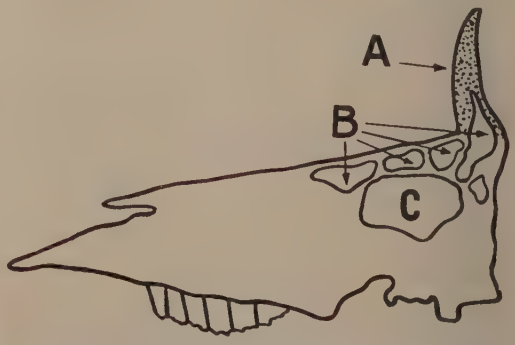

Fig. 3.—Cross-section of the skull of an ox showing A—Horn core; B—Frontal sinuses; C—Brain cavity

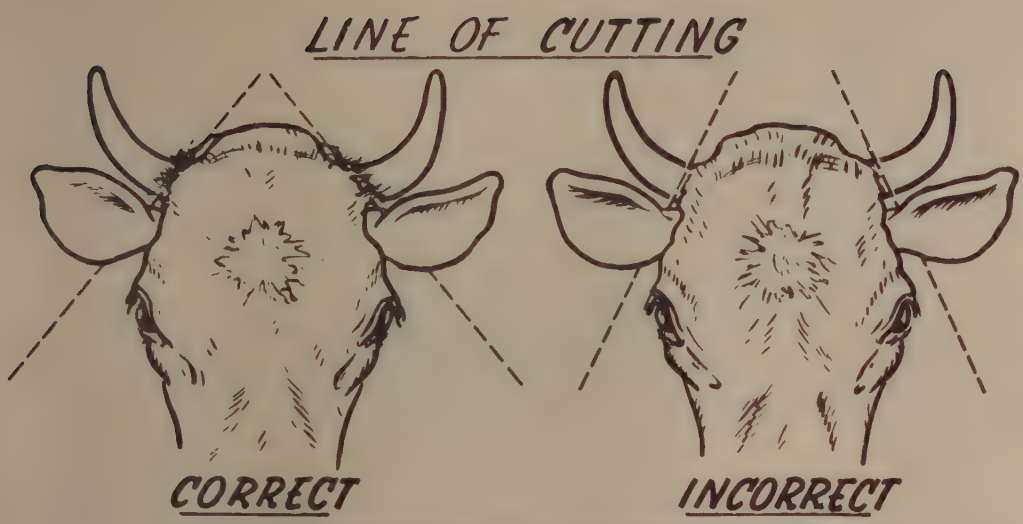

Fig. 4.—Correct and incorrect angles for operating the guillotine-type dehorner

other end is moistened and rubbed over the horn bud until blood commences to ooze from the treated area.

After both horn buds have been treated, the calf should be tied up short for five or six hours, preferably under a roof, so that the caustic cannot be smeared or rubbed on to other calves.

A scab will form over the horn bud and this will come away in due course leaving the animal hornless.

Avoid wet weather which causes the caustic to run. Make sure that the caustic makes contact only with the horn bud and an encircling strip of skin one-eighth to one-quarter of an inch wide. The horn-producing tissues are in this skin and if they are not destroyed an uneven growth of horn "scurs" may occur.

Cauterising Treatment.

A rapid and effective method of preventing horn growth is to destroy the horn-secreting cells with a hot iron, when the calves are a few days old.

Special instruments are available for this work, but suitable dehorning or disbudding irons can be made by any handyman. An ordinary soldering-iron can be made into a disbudding iron by cutting off the tip with a hacksaw to leave a ¾in. square. This is filed to a circular shape and a ½in. hole is drilled in the centre to a depth of about 5/16in. (See Fig. 1.)

A short length of copper or steel tubing welded on to a handle (see Fig. 2) is equally effective.

Where large numbers of calves are to be treated, electrically-heated disbudding irons are often used.

To treat the horn-bud, the iron is heated to a cherry red and applied firmly over the bud. It is rotated with a light firm pressure until a copper-coloured groove is burnt round the horn bud. No further treatment is necessary.

Surgical Treatment.

Up to the age of about three months, the horn is attached only to the skin. Using special disbudding scissors or a sharp knife, the horn and a ring of tissue surrounding it may be removed without difficulty.

DEHORNING ADULT CATTLE

Although disbudding of the animals in calfhood is recommended as the routine treatment, it is often necessary to dehorn herds of adult cattle or adult animals purchased as replacements.

Although dehorning in such cases appears to be a major operation that is attended by considerable bleeding, it is surprising to find that even herds in full production show very little reduction in milk yield and general condition after dehorning.

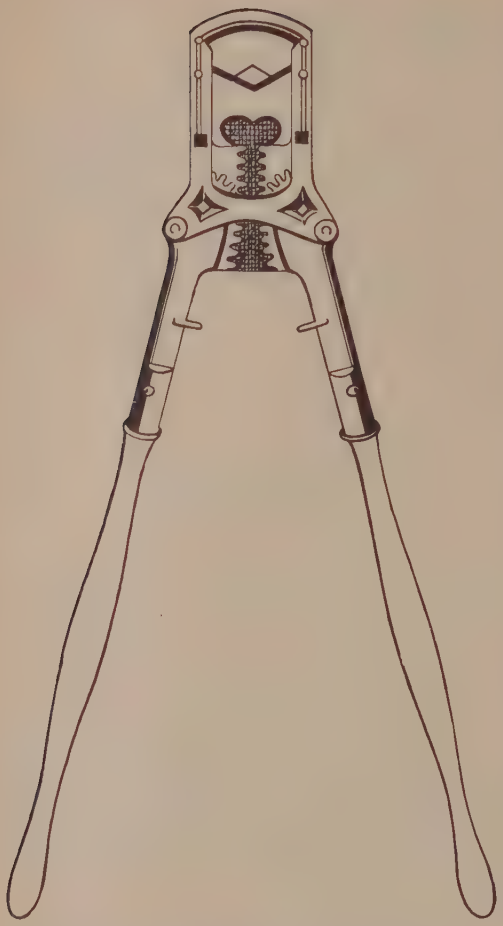

Fig. 5.—Guillotine-type dehorning instrument

Healing is usually rapid, and a few years ago when the Muresk College Guernsey herd was dishorned, several of the cows were shown successfully (completely healed) at the Perth Royal Show just four weeks after the operation.

Equipment Needed.

A strongly-constructed crush and bail, a pair of nose-grips, and a massive guillotine dehorner are needed.

Do not use the milking bails for dehorning. Cows cannot let down their milk if they continue to associate the milking-shed with a painful experience.

Use a stoutly-constructed bail of the swordstick type, preferably on the end of a race where the operators have plenty of room to work. Have a stout rope to serve as a breeching to prevent the animal from backing away when the dehorners are applied.

A study of the section of the skull (Fig. 3) shows the sinuses or hollows in the bony structure, and (Fig. 4) shows the correct and incorrect angles at which the dehorner should be operated.

The guillotine-type instrument shown in (Fig. 5) is cog-operated to give added leverage. The instrument should be soaked overnight in 10 per cent. lysol solution and should be placed in a bucket of 2 per cent. solution after each operation.

An assistant applies the nose-grips and turns the head to one side so that the dehorner can be placed over the upper-

Fig. 6.—Showing bail, rope for breeching, and dehorning in operation

Fig. 7.—One handle of the dehorner rests against the operator's thighs so that both hands may be used to close the handles and sever the horn

most horn with the flat side of the blade downward. The handles are opened wide so that the blade can take a ring of skin and hair ¼in. to ½in. wide surrounding the base of the horn.

A convenient method is that shown in photographs (Figs. 6 and 7) with one handle resting on the operator's thighs so that both hands are used to apply leverage to the other handle, severing the horn with a single clean cut.

The head is reversed bringing the other horn uppermost and the operation is repeated.

In obstinate cases where the horns are very hard, they should be circled with the blades partly closed so that a ring is cut round the horn, after which they will usually come away freely on application of the normal pressure.

In the case of bulls with massive horns it is preferable to have the operation carried out under a local anaesthetic by a veterinarian.

AFTER-CARE

If the dehorning is carried out in dry weather and flies are not plentiful, very little after-care is needed.

Blood flows freely after dehorning, often spurting in streams from severed arteries, but this usually ceases as blood-clots are formed.

After the operation, the cattle should be kept under observation in a yard or small paddock for half an hour. If bleeding is still severe at the end of this period it may be checked by applying a ligature as shown in Fig. 8.

A cord is passed round the poll and tied tightly. Two short lengths of cord are then tied across the top of the poll. Remove the ligature after it has been in position for about half and hour.

Do not apply dressings to the wound as these may get into the sinus and cause inflammation.

Where flies are prevalent it is a wise precaution to apply a suitable repellant to the areas around the wounds—not on the wounds.

The fly repellants used as sheep dressings would be suitable for this purpose. Another very effective repellant is 1 part iodoform mixed with 16 parts boric acid. This powder may be dusted freely round the wounds.

Fig. 8.—Ligature in position

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By K. NEEDHAM, B.Sc. (Agric)
Dairy Cattle Husbandry Officer.

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Belt tightness.
Inflations.
Claw air inlets.
Releaser flaps.
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Relief valves.
Vacuum gauges.

Speaking of relief valves, these are temperamental and if not functioning correctly can cause trouble.

Too little air can cause a high vacuum, teat cup crawl and damage to the udder, leading to mastitis. It would be worthwhile thinking of fitting a Ruakura-type weighted relief valve which is positive and cannot go wrong.

It is impossible to overestimate the importance of a properly running machine—it will save man-hours in the shed and help increase production. Remember that contended cows milk well and produce more.

A NEW YEAR FOR GRADE HERD RECORDING

March 1 ushers in the new year for Grade Herd Recording and with it a new scale of fees. These have been designed to encourage greater continuity of testing and to more equitably spread the financial burden which has resulted from increased costs of maintaining the service. The new scale to apply is:—

	Per Cow. s.	d.
Herds tested for 1 to 3 years	12	6
Herds tested for 4 to 6 years	10	0
Herds tested for 7 or more years	7	6

It will be observed from this scale of fees that consideration has been given to continuity of testing. Those persons who have been testing for seven or more years have received acknowledgment to the extent that they may avail themselves of this service at the lowest rate applicable.

To enable us to arrange a smoother changeover and to organise our units as economically as possible all persons interested in testing are requested to complete their application forms immediately and forward them together with the fee to the District Officer, the Herd Recorder or Head Office. Your assistance and co-operation will be appreciated.

CALF PADDOCKS

With the new season's calf crop not too far away it is time to be planning adequate calf paddocks. One paddock near the dairy is not enough. Calves like fresh young leafy pasture and should be given every opportunity to graze from an early age.

To provide young pasture regularly, try using four calf paddocks which can be rotated at three-weekly intervals.

In addition, rotation of calf paddocks provides excellent insurance against worm infestation and if this procedure is followed regularly it will be found that the incidence of worms is rare.

After weaning the calves should not be confined to their paddocks, but should be allowed to graze ahead of the milking cows in the normal rotational pasture programme.

BUY BULLS FROM TESTED DAMS

Too many farmers are buying bulls on too little information. The appearance of a bull is important to demonstrate his health and constitution. Proved bulls are best, but, where these are not available, some knowledge of the butterfat backing of his dam, his sisters and his daughters is imperative if you hope to improve the production of your herd.

Admittedly it is difficult to buy bulls from tested dams which have passed standard. They are not readily available, but the sooner the demand for them increases the sooner will pure-bred breeders endeavour to meet these demands.

The process of grading up is a slow and expensive one and allows no scope for guessing. Those who are contemplating replacing their bull should make every effort to obtain one from a tested dam which has passed standard.

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INFERTILITY IN RAMS

By J. CRAIG, M.R.C.V.S.,
Senior Veterinary Surgeon

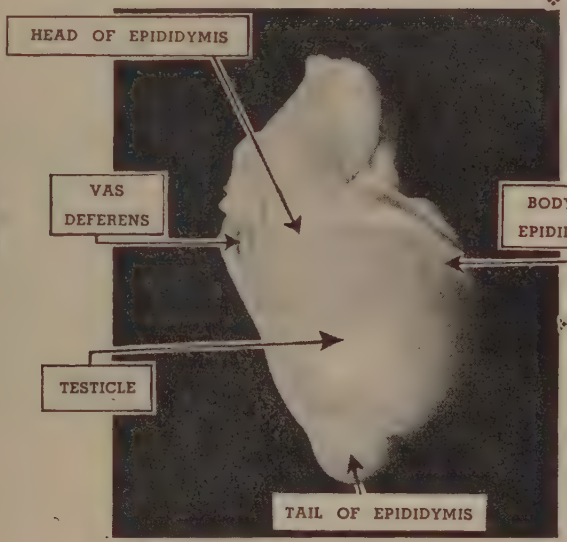

Fig. 1.—A normal testicle showing position of the epididymis and *vas deferens*.

The testicle is the essential organ of reproduction and the sperms which are formed therein are conveyed in a network of fine ducts to converge into one tubule at the head of the epididymis.

The epididymis is closely related to the testicle and consists of a head, body and tail. It continues into the *vas deferens* which in turn leads into the male urethra.

REALISING that good rams play an important role in flock improvement, the wise flockowner selects his rams after careful consideration of their breeding, type, conformation, fleece characters or potential meat-producing qualities. These points are undoubtedly important, but the essential feature of any ram is its ability to get lambs and, for this reason, the intending purchaser should also make certain that the animal is free from genital defects.

Field observations have shown that genital defects are not uncommon among rams in Western Australia. In other States, mass surveys have disclosed that approximately one of every ten rams examined has been so affected.

Impaired fertility and lowered lambing percentages often result from genital defects. Admittedly, such defects are not confined to the sires and, infertility may affect either sex but as we usually mate two to three rams with 100 ewes it is obviously important to ensure that the sires used are normal and possess high fertility levels.

Lowered lambing percentages are not always the result of low fertility in the rams. For instance, the incidence of "clover disease" led to a dramatic fall in lambing percentages, particularly in the 1940-50 period. Malnutrition and faulty flock management can affect lambing percentages, but generally speaking, temporary or permanent infertility in rams is the main cause of low lamb numbers.

CAUSES OF TEMPORARY INFERTILITY

Temporary infertility refers to any condition from which the ram will eventually make a recovery. The extent of this type of infertility is difficult to assess but is probably fairly common.

One of the main causes of temporary infertility in the ram is the variation in the quality of the semen produced by healthy rams. Semen is the male sexual fluid which carries the spermatozoa (sperms) of the male; fertilisation takes place when a sperm fuses with the ovum (egg) of the female.

The manufacture of sperms by the male genital organs can only take place when the temperature of the testicles is below that of the body, and in all the domesticated animals the testicles are so placed as to make this possible. If for any reason, the temperature of the testicles becomes the same as, or rises higher than that of the body, sperm production ceases and the animal is rendered sterile.

Good quality semen contains a large quantity of healthy sperms, but poor quality semen contains only a few sperms or abnormal, dead and inactive ones; these differences can of course only be detected by microscopical examination. Many factors can cause degenerative or abnormal changes in the semen. Under Australian conditions, poor quality semen is commonly associated both with high body temperatures produced in rams by high summer temperatures i.e. when the atmsopheric temperature remains over 90° F. for more than a few days at a time and is accompanied by hot nights; and also with the poor quality of the native pastures during the dry period. These environmental conditions would apply particularly to the pastoral areas of the State, and it seems probable that the poor lambing percentages in the northern sheep areas may be attributed to a combination of these factors.

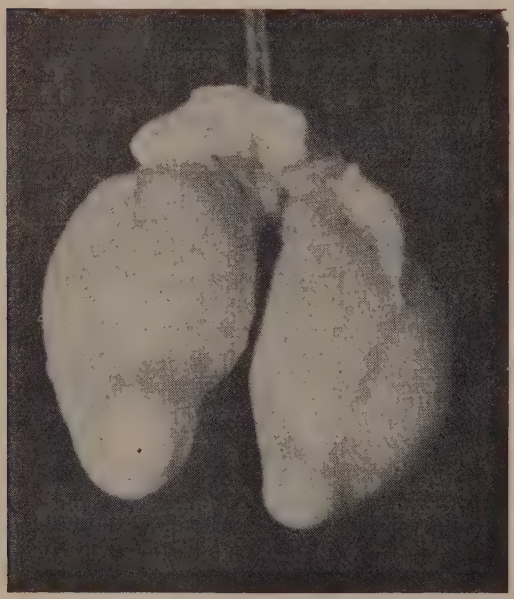

Fig. 2.—Note the variation in size and shape of the tail of the epididymis. In the normal testicle (right) the tail has a well-defined neck; the testicle on the left is infected with epididymitis, the tail is enlarged, hard, and merges into the base of the testicle.

High body temperatures in the ram may also be a sequel to blowfly strike, abscesses, large suppurating wounds and infectious diseases such as footrot and foot abscess. There is some evidence too, that even dipping and jetting with standard arsenical preparations can cause a temporary degeneration of the semen. For this reason, it is unwise to dip rams closer than two months prior to mating. Other incidental factors such as internal parasitism may at times also have an important effect on semen production.

The recovery from specific ailments such as those described does not immediately restore the quality of the semen. In fact an interval of two to three months may elapse before the semen once more becomes normal. A similar period must pass before the semen again becomes normal after the extreme heat of summer or after the pastures have once more become green.

A low Vitamin A diet causes a marked reduction of sperms and it has accordingly been suggested that Vitamin A deficiency may be an important factor in inducing infertility in rams. Since green feed is rich in this vitamin it was believed that poor dry pastures devoid of Vitamin A might be responsible for a poor output of sperms. It is well known however, that the liver of sheep is able to store sufficient Vitamin A secured during the green feed period of the year, to last for four to five months; it is not considered therefore that

Fig. 3.—The testicle on the left shows a gross epididymitis infection which has led to a shrinkage (atrophy) of the testicle on the right.

a deficiency of Vitamin A sufficient to cause infertility in rams, is likely to be found in areas other than those of the pastoral north and east of Western Australia, where prolonged drought conditions are more likely to occur.

In general, the seasonal excellence of the semen of rams corresponds to the periods in which a high proportion of the ewes in that district come into oestrus (heat), and it is thus obvious that this is the ideal time for mating to take place. When most of the rams in a flock refuse to work, the cause is more likely to be due to the absence of heat in the ewes rather than any lack of sexual desire on the part of the ram; on the other hand, when only a few rams fail to work the fault is likely to lie with the rams. Some rams may show a lack of desire to mate and this may be a serious cause of infertility in certain individuals; this specific type of infertility may respond to certain hormone injections. By contrast, vigorous servers are not necessarily highly fertile.

Although the temporary forms of ram infertility may be responsible for low lambing percentages, they may also affect the lambing in other ways, for example, the onset of lambing may be delayed, or having once started, it may be interrupted with the result that lambing may be extended over a considerable period.

CAUSES OF PERMANENT INFERTILITY

Permanent infertility in rams may be caused by a number of conditions; this type of infertility is one from which the affected ram does not recover, although in many instances such a ram may not necessarily be completely infertile. For all practical purposes however, a ram affected with the testicular abnormalities described should be culled from the flock, and any such ram should be rejected at the time of purchase. These abnormalities can be detected fairly readily by manual examination of the ram and are as follows:—

(1) Epididymitis (Inflammation of the epididymis).

(2) Orchitis (Inflammation of the testicle).

(3) Hypoplasia (Degenerated or underdeveloped testicle).

(4) Hyperplasia (Overdevelopment of the testicle).

(5) Cryptorchidism (Failure of the testicle to descend).

(6) Hernia (Rupture).

(7) Varicocele (Varicose veins).

Epididymitis is the commonest and most important cause of permanent infertility in rams. It is usually of bacterial origin i.e. caused by the micro organisms *Brucella ovis* (mainly) and *Corynebacterium ovis* (the "cheesy gland" germ). The low position of the epididymis in relation to the ground renders it especially liable to damage from mechanical causes e.g. due to its striking the ground, rocks or some other elevated object, and a non-infectious epididymitis of this type may result. (See Fig. 5.)

Epididymitis is usually detected as an enlarged and hardened tail of the epididymis at the base of the testicle, but it may sometimes occur in the head or body of that organ. By the time epididymitis can be easily seen and felt, the disease process has reached an advanced state and is incurable; but by contrast, it may be difficult or even impossible to locate the early stage of this condition. When both sides are affected, rams are completely infer-

Fig. 4.—Manual examination of the testicles with the ram standing and sitting.

tile; where epididymitis is present only on one side, the production of semen in the other testicle is adversely affected and although these rams may work well, they have a markedly lower fertility when compared with normal rams.

Orchitis is usually the result of some external injury to the testicles, such as may happen when one ram is horned by another. In the early stages, the affected part may be swollen and hot to touch, and the ram may resent handling; if the skin is broken a secondary infection may also occur. Later, adhesions may be found between the scrotum (purse) and the testicles, which remains enlarged hard and lumpy.

Hypoplasia describes a condition in which the testicle becomes atrophied and fails to reach normal size. Such small undeveloped organs cannot produce sperms, and in adult rams this should be regarded as a serious fault. It may also occur when a chronic or long-standing epididymitis is present, the gross enlargement of the epididymis leading to a corresponding secondary shrinkage of the testicle of the same side. (See Figs. 3 and 7.)

Hyperplasia refers to an over-development of the testicle. When one testicle only descends into the scrotum, the descended testicle commonly becomes affected with hyperplasia, a compensatory response to the absence of its fellow.

Cryptorchidism, a failure of the testicles to descend into the scrotum, may effect one or both testicles, i.e., it may be monolateral or bilateral. Although a ram with only one testicle may be quite fertile, the condition is hereditary and affected rams should be culled for that reason. Since the manufacture of sperms can only take place when the temperature of the testicles is below that of the body, a bilateral cryptorchid is completely sterile.

Hernia may be inguinal or partial when a portion of bowel occupies the inguinal canal in the groin region, or complete when the loop of bowel descends to occupy the scrotum. These forms of hernia may be congenital that is, existing at birth; or acquired, when it occurs later in life. The latter form is mainly due to accidents such as kicks, falls or blows.

Varicocele is the term used when the veins within the spermatic cords above one or both testicles become greatly distended. It is more common in older rams; a ram so affected has an uncomfortable gait and an unwillingness to work.

OVINE BRUCELLOSIS (EPIDIDYMITIS IN RAMS)

The term epididymitis describes a condition that affects only a specific part of the genital organs of rams. Although this abnormality has long been known to occur in rams, it has only comparatively recently shown to be of bacterial origin. As indicated previously, the germ causing epididymitis belongs to the *Brucella* group of organisms, *Brucella ovis,* a germ which is similar but not identical to *Brucella abortus,* the cause of contagious abortion in cattle (bovine brucellosis).

Brucella ovis infection is known to cause not only epididymitis in rams in Australia and New Zealand, but in New Zealand it is also responsible for abortion in ewes. A better term for the disease, implying its wider distribution within the animal body, would therefore be ovine brucellosis.

As far as can be ascertained there has been no case of abortion in Australia which has been traced to the germ *Brucella ovis,* but since it is known that ewes may be harbouring these bacteria without showing any obvious symptoms, they may therefore constitute an important reservoir of infection.

It is known that the bacteria may be present in the semen of an infected ram and therefore the disease may be spread venereally i.e. from an infected ram to a ewe during the act of service, and thence to another ram. Unmated rams may also contact epididymitis, although there may have been no contact with other known infected rams; in these circumstances the infection may have been acquired from pastures contaminated with the micro organisms; whilst the germ *Brucella ovis* has also been recovered from the colostrum (first milk) of ewes.

In the first instance, a diagnosis of epididymitis can be made by handling the affected testicles, although this does not identify the exact cause of the inflammation. This can only be done in one of several ways—by collecting a sample of semen from rams, often a very difficult task, and following this up by examination at the laboratory; or by obtaining blood samples from rams or ewes and submitting these to a blood test, the complement-fixation test. At the present time, no satisfactory blood agglutination test such as we have for brucellosis in cattle, has as yet been evolved.

Despite the fact that mass surveys of rams have been carried out only in two States, ovine brucellosis is known to be present in all States, and it is likely to have much the same type of age and breed distribution in Western Australia as elsewhere. Although epididymitis may be detected by palpation of the genital organs in very young rams, even as young as five months of age, it is more usual to find this disease increasing with advancing age; and it does moreover appear to be more common in British breeds of sheep than in the Merino.

In Queensland, the incidence of clinically detectable epididymitis was 6.7 per cent. among 16,665 Merino rams. In South Australia, the incidence was 7.5 per cent. among 4,550 rams of mixed breeds.

In Queensland, the age incidence among 7,500 rams was as follows:—

Age	Years. 1.	2.	3.	4.	5.	6.	7.	Older.	Total.
No. of epididymitis	24	67	78	31	65	24	21	20	330
Percentage	0·32	0·89	1·04	0·41	0·87	0·32	0·28	0·27	4·40

In South Australia, there was the following age incidence among 2,774 rams :—

Age	Lambs.	2T.	4T.	6T.	F.M.	Total.
No. of epididymitis	1	31	22	26	127	207
Percentage	0·036	0·112	0·79	0·94	4·58	7·5

In South Australia, the breed incidence among 4,550 rams was as follows :—

Breed.	Percentage.
Merino	1·8
Dorset Horn	13·7
Suffolk	8·0
Southdown	17·8
Border Leicester	4·2
Other Breeds	5·7

Fig. 5.—Where the scrotum hangs very low, as in this photograph, the tail of the epididymis is particularly liable to injury.

In commercial flocks, provided 2½ to 3 per cent. of rams are used in mass matings, the lambing percentages may be quite good and the flock owner may have little or no idea that some of his rams may be infertile; in most instances; the normal sound rams would cover up for the others.

In stud properties by contrast, epididymitis can have serious effects where single matings are carried out. Furthermore, the return of affected rams after purchase, would be detrimental to the reputation of the stud.

METHODS OF EXAMINATION FOR GENITAL DEFECTS

This can be carried out either with the ram held by the head and standing in the normal position, or the animal can be held in the sitting position as for shearing. To begin with, the area above the testicles is examined for varicocele, hernia or abscess formation ("cheesy gland"). This is done by grasping the spermatic cords between the thumb and fingers of each hand. (See Fig. 4.)

The hand should then be passed down the testicles so as to identify any abnormalities there, such as may be due to adhesions between the purse and the testicles, to undue firmness or lumps within the testicles, or to enlargement of the head or body of the epididymis. Finally at the base of the testicles, any variation in the size or texture of the tail of the epididymis can be felt.

The head of epididymis is long and curves over the upper end of the testicle and down the upper third; the body is narrow and lies lateral and posterior. The tail is large and is attached closely to the lower end of the testicle.

The normal tail is fairly soft and has a well-defined neck. If this neck cannot be clearly identified, such a ram should be suspect, since with a well-marked epididymitis, the base of the testicle and the epididymis itself appear to be one solid structure.

The testicles vary in size from ram to ram, but unduly large or small testicles should be regarded as faulty, especially if they do not correspond with their fellows. The testicles should feel relatively firm, not unduly soft or flabby, and not very hard; and on handling they should move freely within the skin of the scrotum.

Clearly then, a definite routine should be followed when examining rams and constant practice with normal rams, in order to learn what is abnormal, is extremely important.

Fig. 6.—The enlargement of the tail of the epididymis (right) may be seen clearly in this photograph.

Fig. 7.—A gross enlargement of the testicle on the right, with corresponding atrophy of the organ on the left.

GENERAL RECOMMENDATIONS

It is possible to avoid the conditions associated with, or leading to, temporary infertility by carrying out sound animal husbandry practices. Wherever possible, rams should be kept in shaded well-grassed paddocks with easy access to water. At mating time rams should be in good but not over-fat condition, and driving during the heat of the day should be avoided. Modern blow-fly control measures should be a flock routine and dipping with arsenical solutions should not be carried out close to mating. Finally, since young rams are more vigorous and more fertile than older rams—the ram flock should be regularly replaced by young rams.

Genital abnormalities leading to permanent infertility can only be diagnosed if the flock owner is willing to handle his rams and eliminate any faults that may be detected. The most important of these is of course epididymitis and for the control of this the following routine should be carried out:—

(1) Dispose of any ram affected with epididymitis—for slaughter.

(2) Examine rams prior to purchase and reject any abnormal ram.

(3) Check rams before mating and again after mating; cull for epididymitis and any other genital abnormalities.

(4) Keep the ram flock young.

(5) Keep young rams separated from older rams.

Lastly, it should be remembered that there are certain basic procedures in flock husbandry which should be followed in order to gain satisfactory lambing percentages.

These include:—

(a) A sudden improvement in the nutrition of ewes prior to mating ("Flushing").

(b) The use of 2½-3 per cent rams at mating time, so as to provide a margin for any possible ram infertility.

(c) The placing of one-third of the rams (1%) with the ewes in the first instance, and the remaining two-thirds of the rams (2%) two weeks later. It is possible of course to obtain this same effect by the use of "teaser" rams turned in with the ewes two weeks before the fertile rams.

FREE SERVICE TO FARMERS

Do you know that the Department of Agriculture provides a comprehensive service of advice and technical assistance to farmers, free of charge?

When in need of advice, get in touch with your District Officer whose name and headquarters township will be found in the list of Departmental personnel on Pages 134/135.

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KENT OATS

A PROMISING NEW VARIETY FOR EARLY GRAZING IN THE SOUTH-WEST

By

F. E. RYAN, B.Sc. (Agric.), Agrostologist

and

F. BRIDGMAN, B.Sc. (Agric.), Agricultural Adviser

KENT, a new oat variety bred at the Wongan Hills Research Station, has given very promising results in early grazing trials conducted at the Denmark and Wokalup Research Stations. It makes vigorous growth early in the season—a desirable feature in the dairying districts.

Oats are grown on dairy farms for grazing or hay, but seldom for grain. The variety of oats to use for any specific purpose is rarely considered and the practice of purchasing unnamed feed oats for seed is common. Whatever the purpose required, the choice of a suitable oat variety should be given careful consideration.

Early autumn and winter feed can be obtained on dairy farms by sowing oats "in the dry." The oats may be sown on the surface of the ground and then disced into the soil before the first rains, or the land may be disc cultivated prior to and following sowing. They germinate with the first rains and make vigorous growth while the warmer temperatures of autumn last. This practice is a valuable aid to pasture management in the autumn. By grazing the oats instead of pasture in other paddocks, seedling plants in the pasture are given a better chance to become well established for greater production later in the year.

For best results the oats should be strip-grazed and an electric fence is valuable for this purpose. Spoilage due to trampling is minimised and short grazing with long intervals between grazing enables better recovery of the oats.

VARIETIES FOR EARLY GRAZING

Varieties required for early grazing need to make rapid growth in the autumn and winter. They are grazed out during this

Table 1.—DENMARK RESEARCH STATION.—OAT VARIETY GRAZING EXPERIMENTS.

Average Air Dry Yields rof First Grazing Cuts, 1953–55.

Varieties.	1953. (Sown 12th May.) 1st Cut 25th June.	1954. (Sown 4th May.) 1st Cut 21st June.	1955. (Sown 11th May.) 1st Cut 7th July.	Mean, 1953–55. Cwt. per acre.	Mean, 1953–55. Percentage of Algerian.
	Cwt. per acre.	Cwt. per acre.	Cwt. per acre.		
Kent	1·04	3·70	2·85	2·53	130
Fulgham	1·02	3·33	2·30	2·22	114
Algerian	1·20	2·73	1·95	1·96	100
Avon	·65	2·43	1·95	1·68	86

Table 2.—DENMARK RESEARCH STATION.

Air Dry Yields for Combined Grazing Cuts, 1953–55.

Varieties.	1953.	1954.	1955.	Mean 1953–55.	
	3 Grazing Cuts Combined.	3 Grazing Cuts Combined.	2 Grazing Cuts Combined.	Cwt. per acre.	Percentage of Algerian.
	Cwt. per acre.	Cwt. per acre.	Cwt. per acre.		
Kent	3·27	8·05	5·62	5·65	110
Fulghum	4·15	8·75	4·57	5·82	113
Algerian	3·90	7·72	3·87	5·16	100
Avon	2·77	7·50	3·97	4·75	92

period and are not expected to produce a hay crop on recovery. Experiments on varieties of oats for grazing and subsequent hay have been conducted by the Dairy Division of this Department for a number of years, particularly at Denmark Research Station.

From the results of experiments up to and including 1952, Wongan oats was recommended for sowing for early grazing. In these experiments the standard variety for comparision was Fulghum and this variety is also capable of good early growth. After 1952, a number of new varieties from overseas and also crossbred varieties developed at the Wongan Hills Research Station were included in the trials.

At Denmark Research Station, three cuts in 1953, three cuts in 1954 and two cuts in 1955 were made in the winter period to estimate grazing yields (each cut being followed by a short intensive grazing). At the end of August, the experimental areas were left ungrazed to allow subsequent hay yields to be obtained. The yields of the first cuts which best indicate the value of the varieties for early grazing, are shown in Table 1. In Table 2, the combined figures from all the grazing cuts in each year are given. In Table 3 the results of an early winter cut in the 1955 experiment at Wokalup Research Station are shown. No subsequent cuts were made at Wokalup as wet conditions damaged the experimental plots.

In the first cut in 1953 at Denmark Research Station results were inconclusive with no real differences between varieties. But in the first cut for 1954 Kent was promising, while in the wet year of 1955, it was outstanding in the both grazing cuts made. In combined cuts for each year, the yield of Kent was also good and comparable with Fulghum. At Wokalup Research Station, Kent was clearly the best variety in the cut made in early winter, 1955.

Kent is thus promising for early grazing, making good growth early in the season to provide valuable feed when most required and also some further grazing later in the winter. Its hay yields are only moderate and in any case it is likely to be ready for hay making at a time when weather conditions are unsuitable.

Whilst neither Kent nor Wongan provide more total grazing than Fulghum, they are more productive early in the season and this is the main consideration for oats which are sown "in the dry."

DESCRIPTION OF KENT

Kent was bred at the Wongan Hills Research Station and released in limited quantities of seed in early 1956. Before release it was designated as W30.

Kent is an early maturing oat, flowering slightly before Ballidu. Straw strength is good, stems are fairly fine, the leaves are broad and long while its habit is erect with moderate stooling for an early variety. Its vigorous early growth enables it to produce a large bulk of early feed when other varieties are still relatively backward.

SEED SUPPLIES OF KENT

Pedigree seed released in early 1956 was soon exhausted but further seed will prob-

ably be available in the 1957 season. It is not known for certain when graded seed (the seed usually purchased for sowing for grazing) will come on the market but it should not be very long before it is freely available. Dairy farmers desiring it for early grazing are advised to watch out for graded Kent seed and ask their suppliers to reserve for them any that does become available. Until Kent can be freely obtained, Wongan or Fulghum can be used for early grazing.

ACKNOWLEDGMENTS

The work on oat variety trials was carried out by V. Weston, the manager and A. S. James, assistant manager of Denmark Research Station and by K. W. Simes, the manager of Wokalup Research Station and we wish to acknowledge their assistance.

The tables only show the results for the better and more important varieties in regard to grazing yields for the various experiments concerned. Other varieties which were included in these experiments, but are not shown here, were Acacia, *Avena byzantina,* De Soto, Jongensklip, Lang-gewans, Nicholson's Improved, Nortex, W27, W28, W31 and W32.

Table 3.—WOKALUP RESEARCH STATION.—OAT VARIETY EXPERIMENT, 1955.

**Green Yields for First Grazing Cut.*

Varieties.	Average Yields for First Grazing Cut. 26th June.	
	Cwt. per acre.	Percentage of Algerian.
Kent	90·8	141
Algerian	64·2	100
Avon	63·0	98
Fulghum	56·8	88

* Air dry yields here were affected by moulds in some degree and hence the green yields are more reliable.

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INSECT Pests AND THEIR CONTROL

By C. F. H. JENKINS, M.A., Government Entomologist

NEW INSECTICIDES FOR HOUSEFLY CONTROL

FOR some years DDT has been used with more or less success against the housefly. It and the related insecticides, chlordane and dieldrin, belong to the group known as the chlorinated hydrocarbons and all have been used extensively as residual fly-sprays. Although initially satisfactory results were obtained, resistant strains of insects have emerged over a period of years and these sprays have become less and less effective.

The toxicity to humans of another insecticide group—the organic phosphates (which includes "Hexone" and parathion)—has until recently precluded their wholesale use against the housefly. However, with the development of new and relatively harmless members of this group the organic phosphates can now be expected to play a very important role in fly control.

The most promising of these are malathion, diazinon and dipterex. In recent tests each has been shown to give excellent kills and they are especially useful against the resistant populations mentioned above.

Malathion.

This insecticide first became generally available in Western Australia in 1955 and because of its comparatively low human toxicity rating and comparable insecticidal properties displaced parathion in the control of lucerne flea and a number of other pests. It was found to be particularly effective against the housefly when used as a wet sugar bait. In this form it has given good control in dairies and poultry sheds when applied to posts, walls, concrete floors, etc. The bait should be prepared according to the following formula.

1 oz. 50 per cent. malathion.
1 lb. sugar.
1 gallon water.

Diazinon.

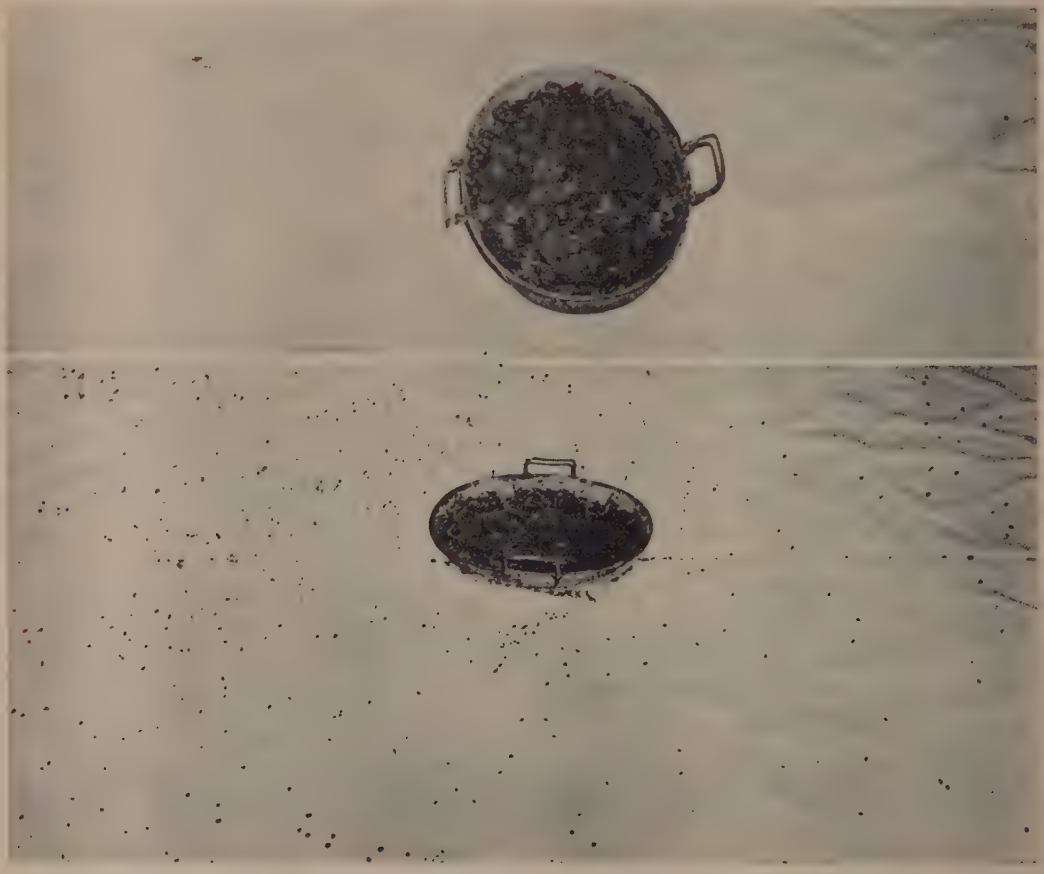
This material has been tested both as a dry bait preparation and as a residual spray. Spectacular kills have been achieved with 0.5 per cent. spray at which concentration the insecticide has been observed to retain its killing power for some weeks.

Satisfactory results have also been obtained with the diazinon dry bait formulation. This material is available in special dispensers and should be used in accordance with the manufacturer's directions.

Dipterex.

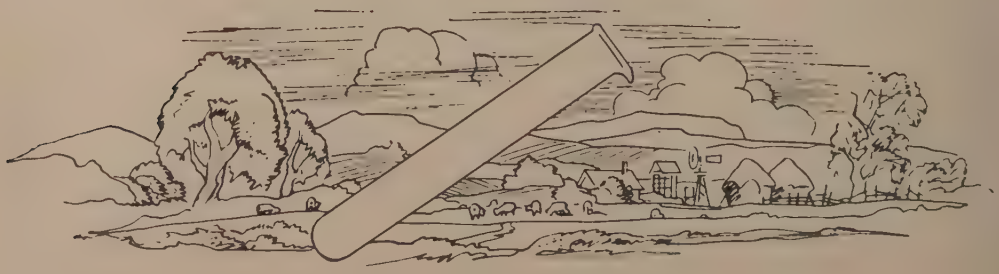
As with diazinon, this new "phosphatic" insecticide has given excellent results as a residual fly spray. At the recommended dilution rate of 1 oz. in 3 gallons only small quantities are required. Good kills have also been observed with this material some weeks after application.

Despite the fact that the insecticides discussed show great promise it must be emphasised that such treatments can only give control when the necessary attention is paid to general hygiene and the disposal of manure. On no account should baits and sprays be used as an alternative to the more fundamental activities.



The upper picture shows a dish containing untreated moist fowl droppings placed in a fly-infested fowl run. It was soon harbouring a large number of fly maggots.

The lower picture shows the results of treating similar material with 0.5% diazinon. No maggots developed, the manure was covered with dead flies, and the dish was surrounded by flies killed by contact.



FAT LAMB PRODUCTION IN WESTERN AUSTRALIA

By
N. DAVENPORT, B.Sc. (Agric.),
Senior Adviser (Meat Production)

THE production of fat lambs may be considered to have become a major feature of the West Australian sheep industry in 1931, for it was in that year that lamb production first exceeded the State's internal requirements, and provided a surplus for export. Since then there has been a seasonal export of lambs every year, mainly to the United Kingdom.

The lamb export policy was developed as the result of recommendations made by an honorary consultative committee formed in 1929 to advise the Government on the problem of the State's surplus sheep.

There has been a marked expansion of fat lamb production since those days. Home consumption has risen from 217,000 carcasses in 1930 to 431,000 in 1955-56—in which season a further 211,000 carcasses were exported. Although the home market is still the main outlet, the availability of an export market at satisfactory price levels is important as a buffer against unduly depressed prices during the periods of peak supplies in the spring.

EXPANSION FACTORS

The increased establishment of improved subterranean clover pastures resulting from the extensive use of superphosphate and other fertilisers; the considerable areas of virgin land in sheep-raising areas which have been brought into production since World War II, and the increased local demand for lamb carcasses are the main factors which have stimulated lamb production in Western Australia.

The local demand has risen with the increased population and also with the greater purchasing power of the individuals.

A noticeable feature of the virgin land development has been the production from recently-developed areas in the south of the State.

The buoyancy of the lamb industry is markedly influenced by the relative returns of sheep-farming for wool and for lamb production.

During the immediate post-war years and until 1952 there was a progressive decrease in the number of British breed rams used in the State, but these increased by 3,000 in the period 1953-56 and at the present time the British breed ram population is at its highest level since the war. The demand for such rams at present exceeds the supply.

Fig. 1.—Australian lambs—including carcasses from Western Australia—exhibited at the Smithfield Market, London, by the Australian Meat Board

MARKET REQUIREMENTS

In order to determine the requirements of the export trade, the 1929 consultative committee made inquiries into the type of carcass which was best suited to the United Kingdom market. It was found that "the greatest demand was for a sucker lamb carcass weighing 28-36 lb. bred preferably from a Down-type ram and compact and symmetrical in shape. It should have a high proportion of meat and be well fleshed on all four quarters, particularly in the loin and hindquarters with short bones and a minimum of fat. When on the hooks the space between the hind legs should be in the form of a U rather than a V. Fat covering is important. It is thickest on the back and sides and thins out towards the lower ends of the legs. While not being too thick on the back there should be a thin covering over the meat of the legs, particularly towards the extremities, which is so important in preventing damage by freezing and drying out when in the oven."

The results of these early inquiries are equally true today, except that demand is for even less fat than previously. While such carcasses are most in demand however there is a definite market for lower quality and heavier carcasses.

Lamb carcasses are marketed in four quality grades, viz Down, first, second and third. The Down grade is reserved for the highest quality carcasses showing the effect of the "Down" sire in producing a compact very well-fleshed short-boned carcass that is not over-fat. Within each quality grade are four weight-grades, viz.: "D's" of 20-28 lb.; "2's" of 29-36 lb.; "8's" of 37-42 lb.; and "4's" of 43-50 lb.

Although, as previously stated, there is a definite market for the lower quality and heavier carcasses, the present price levels on the United Kingdom market indicate a preference for lightweight carcasses, even at the expense of quality.

The difference in price per lb. between the first and second grade carcasses is

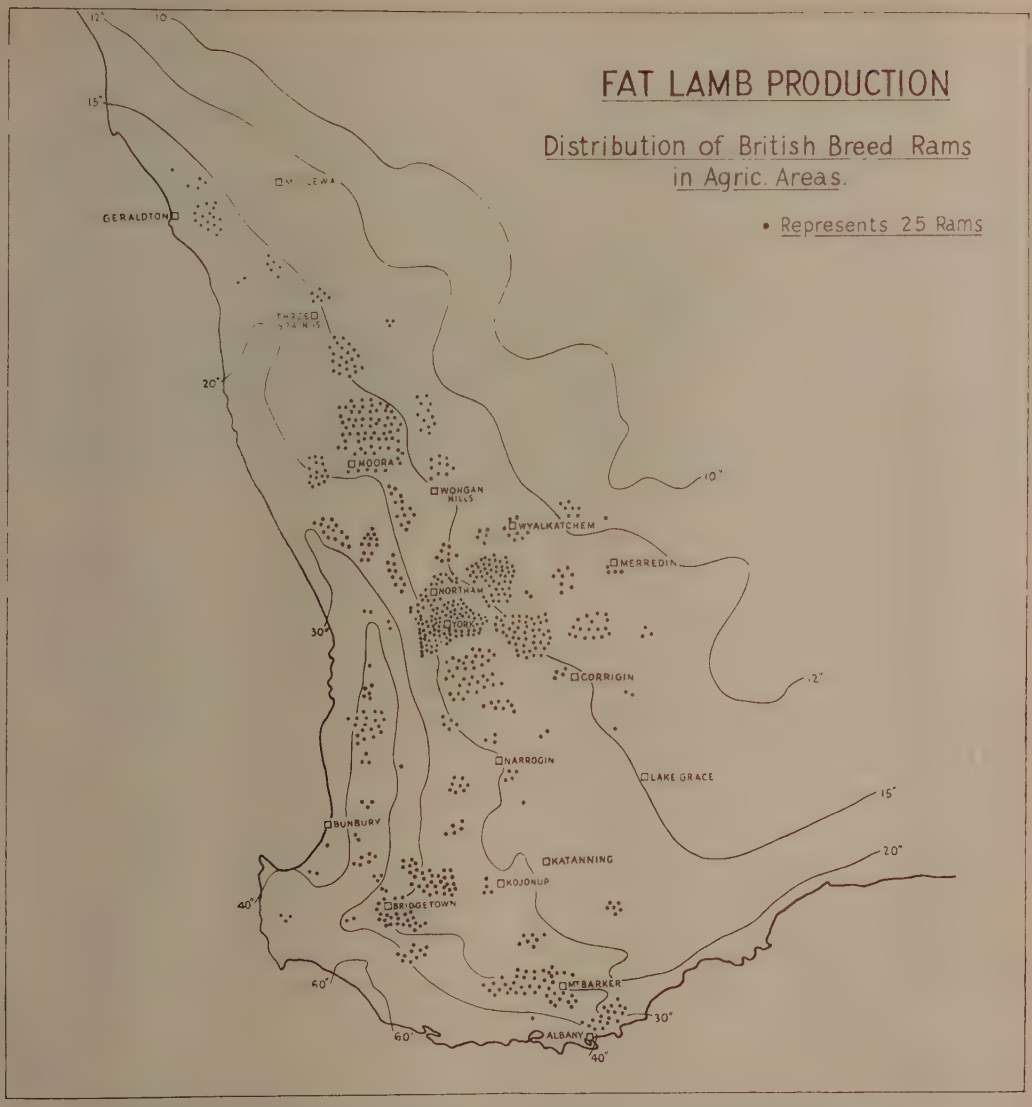


Fig. 2.—A map showing the distribution of British breed rams in Western Australia (Compiled from information supplied by the Government Statistician—March, 1956)

usually less than the difference between the 29-36 lb. and 37-42 lb. carcasses in the same quality grade.

The local market, which in earlier years was not particularly insistent upon quality, has gradually become more exacting, and home consumption prices now tend to show much the same relationship to quality as that encountered in the export market.

DEVELOPMENT OF THE INDUSTRY

The Merino, which is the principal Australian sheep breed, was developed as a wool-producer and is definitely not a meat type. Its carcass conformation falls far short of export requirements and the ewes do not produce milk in the quantities essential for the rapid growth of high quality lambs.

Fig. 3.—Large-framed Merino ewes suitable for breeding first-cross lambs

To produce lambs suitable for a discriminating market it was found necessary to introduce suitable British meat breeds into the lamb-raising programme.

These were of two main types, the Longwools—mainly represented in this State by the Border Leicester, English Leicester and Romney Marsh—and the Shortwools or Down breeds of which the most popular are the Southdown and the Dorset Horn.

The Longwools are dual-purpose sheep combining good mutton qualities with the production of heavy, long-stapled fleeces.

The Shortwools are pre-eminent as meat producers, with chunky, well-fleshed and quick-maturing carcasses, but their wool-production is of minor importance.

The relative popularity of the various British breeds in this State is shown by these details of ram numbers at March 31, 1956.

Type.	Breed.	Number.
"Longwools"	Romney Marsh	3,438
	Border Leicester	2,019
	English Leicester	714
"Shortwools"	Southdown	6,924
or "Downs"	Dorset Horn	4,977
Other breeds of both types including Suffolk, Shropshire and Ryeland		1,444
		19,516

Following upon research into the breeding of lambs carried out in other parts of the Commonwealth and New Zealand, an investigation was conducted at the Avondale Research Station near Beverley during 1931-33 to determine the most suitable breeding programme for the production of high quality lambs.

The results of this work, together with the experience of lamb raisers showed that:—

(1) Lambs suitable for both the local and export markets could be obtained by mating Merino ewes with British breed rams.

(2) Crossbred ewes were superior to Merino ewes and, mated to Down-type rams, particularly the Southdown, produced lambs of high quality.

(3) The most suitable types of crossbred ewes were obtained by mating Merino ewes with Longwool breed rams, particularly the Border Leicester and the English Leicester, with the Romney Marsh preferred in the wetter areas.

(4) The Southdown was unsurpassed as the sire for the ideal export type but the Dorset Horn was well suited for the production of early-maturing lambs in the shorter season districts.

The development of the industry has been based on these findings.

Fig. 4.—Crossbred ewes (Border Leicester-Merino) at the Avondale Research Station. Such ewes are well suited to the production of high quality export lambs when mated to Southdown rams.

LAMB RAISING AREAS

The principal lamb-producing areas, generally referred to as the "lamb belt," lie approximately within the 15in. to 30in. rainfall areas, where the establishment of improved pastures with subterranean clover as the basic legume is general practice. The seasonal conditions are very dependable and lambs can be marketed as suckers each year. The production potential of the lamb belt is high. This region contains about ten million acres of cleared country of which some three and a half million acres are under improved sub-clover pasture. The sheep population is approximately 6,000,000. Production per acre is increasing steadily and in addition there are considerable areas of virgin land yet to be brought under cultivation.

In the areas with a lower annual rainfall, seasonal conditions are not as constant, with the result that in occasional years, lambs may not "finish" satisfactorily, and production is therefore somewhat irregular.

An indication of the areas in which lambs are produced for slaughter is given in the accompanying map which shows the distribution of British breed rams throughout the agricultural areas.

BREEDS AND BREEDING

The Merino Ewe.

Compared with crossbred ewes, Merinos do not usually have such high fertility levels, are not quite so efficient in "mothering" their lambs, and secrete less milk, consequently their progeny are somewhat slower in reaching marketable weights.

Nevertheless Merino ewes play an important role in our lamb-breeding programme. They are used mainly in the less-favoured lamb-producing areas where large-framed, medium to strong-woolled types of ewes are mated to Longwool rams to produce first-cross lambs of satisfactory quality for both the home and export markets.

The first-cross ewe lambs are in demand as potential mothers of high-quality export lambs sired by Down rams.

Mated to Dorset Horn rams, suitable Merino ewes produce early lambs of somewhat better quality than the progeny of the Longwool-Merino cross. Because of their lower fleece values however, the female progeny of the Dorset Horn-Merino cross are not favoured as breeders.

The relatively high fleece value of the Longwool-Merino cross causes it to be preferred as a "carry-over" lamb, in cases where bad seasons or other factors prevent the sale of lambs as suckers.

As lambs from Merino ewes are of lower value than those from the Longwool-Merino cross ewes, the value of the ewe's fleece is particularly important when considering the aggregate return per ewe in

Fig. 5.—High quality second-cross lambs bred at the Avondale Research Station. These are the progeny of Border Leicester-Merino ewes mated to Southdown sires

lamb and fleece values. Merino fleeces are usually more valuable than crossbred fleeces.

An important feature of the Merino ewe is that its breeding season usually commences about four weeks earlier than the crossbred. As the lambs usually mature about three to four weeks later than those of the crossbred, the lambs from both types of ewe tend to reach marketable condition at about the same time, when each ewe flock is mated at the commencement of its particular breeding season.

It is a common practice for Merino wool-producers throughout the sheep-raising areas to mate cast-for-age Merino ewes with Longwool or Dorset Horn rams and to sell both the ewes and the lambs.

The Crossbred Ewe.

The term "crossbred" is generally used to describe the half-bred progeny of Merino ewes mated to Longwool rams. As was previously explained, the progeny of Merino ewes mated to Shortwool rams are not favoured. Their better carcass conformation does not compensate for the lowered fleece values compared with the Longwool-Merino cross.

Compared with the Merino, the British breeds (particularly the Border Leicester and Dorset Horn) have faster growth rates, higher fertility levels, better milking qualities and superior carcass conformation as meat producers. Their breeding season commences later than that of the Merino.

In the case of the crossbred ewes, these advantages and disadvantages lie about midway between those of the Merino and the particular British breed used as a sire.

Lambing percentages of crossbred ewes are high and they are good mothers. Milk production is usually ample, even for the nourishment of twin lambs.

Because of these qualities, crossbred ewes are in keen demand by breeders in the lamb belt for mating with Down rams to produce high-quality lambs. The demand is such that it is common practice to purchase requirements as lambs and hold them for mating as two-tooths in the following year.

The three principal types of crossbred ewes in use in Western Australia are:—

(1) *Border Leicester-Merino* ewes which are suited to conditions throughout the lamb belt except in the higher rainfall areas.

They have a high milk yield and are considered the best of the three crossbred types in this respect. The high growth rate of the Border Leicester breed is shown in the relatively quick maturity of lambs from these ewes.

(2) *The English Leicester-Merino* cross ewe is in less general demand than the Border Leicester-Merino cross but is preferred in the Avon Valley and Great Southern dis-

Fig. 6.—Border Leicester ram

tricts where it has proved itself to be well suited. This type of ewe has the advantage of a somewhat lower-set and less leggy conformation than the Border Leicester crossbred. However its progeny do not grow quite as rapidly and take longer to reach market standards.

(3) *The Romney Marsh-Merino* cross ewe is favoured in the heavier rainfall districts where wet pasture conditions during the winter and spring emphasise its advantages over the Border and English Leicester crossbreds. It is used extensively in the Lower Great Southern areas and particularly in the lamb areas adjacent to the southern seaboard. It is of good conformation and the returns compare favourably with those of the Border Leicester cross.

The influence of the slower maturing Romney Marsh breed is shown in the progeny from this type of crossbred. They take rather longer to mature than lambs from the Border Leicester-Merino crossbred ewes.

The Corriedale Ewe.

This is a dual-purpose breed with regard to meat and wool production and the ewes are well suited for breeding high-quality lambs, although they rank somewhat lower than Longwool-Merino crossbred ewes for this purpose. The carcass quality is not as high, and the lambs take longer to mature. The ewes have the advantages of mating earlier than crossbreds, and wool returns are higher. In view of the shortage of crossbreds, Corriedale ewes are in keen demand but supplies are very limited.

The Southdown Ram.

Rams of this breed are superior to all others as the sires for high-quality lightweight lambs. The Southdown is suited to the conditions throughout the lamb belt from the Geraldton area in the north to the southern coast. The rams work freely, quite as well as Dorset Horn rams, in fact there is no difference between the two breeds in this respect.

Southdown lambs from crossbred ewes mature—or in other words develop to the stage when they have the desired proportion of bone, meat and fat—at lighter weights than lambs sired by rams of other British breeds from similar ewes. This is important when the tendency of market demand today is towards lightweight carcasses. At weights above 36 lb. or so, these second-cross lambs readily become over-fat. This is not so with the first-cross lamb from the Merino ewe, which has less tendency to become over-fat than th

Fig. 7.—English Leicester ram

second-cross lamb. First-cross Southdown-Merino lambs also mature at lower weights. The carcass is about 2 to 3 lb. lighter than that of the Longwool-Merino first cross.

The Dorset Horn Ram.

Where quick-growing lambs are required, such as for the early market or in the more northern districts with a shorter growing season the Dorset Horn is well suited for the purpose. Dorset Horn-sired second-cross lambs mature two to three weeks earlier than Southdown-sired lambs from similar ewes, and the carcasses are 2 to 3 lb. heavier. Although their carcass conformation falls below the high level of Southdown-sired lambs, Dorset-sired lambs are well suited to both the export and local markets.

Other Down breeds such as the Suffolk and Ryeland have increased in numbers in recent years, but neither is as suitable as the Southdown for the production of lightweight sucker lambs.

The Border Leicester Ram.

Conditions in the lower rainfall areas east of the lamb belt favour the use of the earlier-maturing breeds such as the Border Leicester and Dorset Horn. When Border Leicester rams are mated to Merino ewes, the lambs have ready sale in local markets particularly when produced early in the season although they are not of high quality by export standards. The value of the pelt is considerable. Should the conditions of the growing season not permit the lambs to "finish" as suckers, they are suitable for carrying over in view of their satisfactory fleece value. The principal value of this breed is that the first-cross ewe lambs from Merino ewes are particularly suitable as mothers for breeding second-cross lambs in the lamb belt. They command a premium over their meat values for this purpose.

The English Leicester Ram.

This breed is not as widely favoured as the Border Leicester as it is somewhat slower-maturing. The first-cross English Leicester-Merino ewe is however, highly valued for its conformation as the potential mother of export lambs.

The Romney Marsh Ram.

These rams are now the most numerous of the Longwool breeds in this State. They are preferred to the other Longwool rams for mating to Merino ewes under the wetter conditions of the more favoured districts. The ewe progeny of this cross are in keen demand as breeders in the heavier rainfall areas. When carried over the hoggets fatten readily and yield good fleeces.

SELECTION OF RAMS

Each ram will be expected to sire many lambs, and its influence on the quantity

Fig. 8.—Romney Marsh ram

and quality of the lamb drop will be considerable. Rams are usually purchased as two-tooths (1½ years old). At this age, they are sexually mature and are quite capable of mating at the ratio of three rams per 100 ewes. The average working life of a British breed ram is four to five years, after which fertility can drop quite sharply.

Features of a good ram are a general alert and healthy appearance, good feet and the ability to walk well; legs set well apart; well-sprung ribs without weakness behind the shoulder, a broad level back showing good loin development, the topline continuing on to the tail without falling away unduly and carried down to a deep full twist. Fleshing should be good down to the knees and hocks. The mouth should be normal and the animal should carry a good even fleece typical of the breed.

When purchasing rams it is important that careful inspection should be made of the testicles to ensure that they are in good condition; that there is no abnormal development and particularly no indication of epididymitis, which is a common cause of infertility in British breed rams. It is a disease caused by a specific bacterium which becomes established in the epididymus, normally a small soft knob at the base of each testicle. The epididymus is a channel for the passage of sperm from the testicles. Inflammation resulting from bacterial infection causes swelling and blocking of the duct which carries the sperm, with partial or complete infertility as the result. The disease can spread through the ram flock.

SELECTION OF EWES

Farmers whose principal income is derived from lamb breeding, usually prefer to purchase their ewe requirements, whether they are crossbreds or Merinos. The practice of running a ewe-breeding flock and a lamb-breeding flock on the one property is not favoured.

The mutton qualities of crossbred ewes have been improved appreciably over those of the Merino by the influence of British breed sires. As they are used essentially for breeding top-quality lambs it is necessary that they should exhibit pronounced mutton qualities. They should be low-set and blocky within the characteristics of the type. For instance, the Border Leicester cross ewe tends to be more leggy than the Romney Marsh or English Leicester cross. They should have good width of brisket, be well set behind the shoulder and have well-sprung ribs indicating a broad back and well-developed loin. They should not be hollow-backed, and the topline should not fall away unduly at the tail. Well-filled hind legs, set well apart, is an important point for selection. The better the crossbred ewe, the better the second-cross fat lamb.

Fig. 9.—Southdown ram

Research in New South Wales has shown that the better type ewes produce lambs of heavier carcass weights.

Results of research at the Avondale Research Station have shown that breeding from crossbred ewes of greater than average size, is of no advantage with regard to the size of the lamb produced, and therefore presumably also to the growth rate and quality of the lamb. As the maintenance requirements of sheep are proportional to their size, crossbreds of above average size could show a smaller net return per year. This need not necessarily be so with Merino ewes for which milk production is such an important factor for lamb growth for the first eight to ten weeks. In fact, higher milk yields may generally be associated with heavier ewes.

A robust well-fleshed type of Merino ewe should be selected. The narrow slab-sided ewe should be avoided. The South Australian type of sheep is well suited for crossing with British breed rams.

The wool yield of the ewe flock is an important consideration as, on present price levels for wool and lamb, the wool returns fall little short of the value of the lamb. This applies with equal emphasis whether the flock be either crossbred or Merino.

Ewes should be selected when in good condition but not fat and at least half woolled for preference.

MATING

The breeding season for Merino ewes in the earliest lamb producing districts commences during early November. This is sufficiently early for the lambs to finish as suckers except in abnormal seasons.

For crossbreds ewes the season commences about a month later than Merinos. In the Geraldton area this is in early December. The breeding season is later as we move southwards, commencing in late December in the Avon Valley and mid-January in the most southern districts.

Early lambing is desirable in the northern areas so that the lambs can finish before the pastures dry off and grass seeds become troublesome. For this reason, a few Dorset Horn rams are useful towards the end of the mating period in these districts to replace Southdown rams so that the last lambs will mature more quickly.

In the areas adjacent to the southern seaboard where mid-winter conditions can be harsh, spring lambing is becoming more popular. In these districts the growing season is long and can extend at times into December. Ewes can thus lamb down on good pasture and raise their lambs under conditions favourable to milk production.

The income from the flock is markedly influenced by the percentage of lambs dropped. Every care should be given to

Fig. 10.—Dorset Horn ram

this aspect of flock management, and the fertility of the rams is of particular importance in this regard.

As rams of the British breeds do not maintain a high level of fertility over many years the ram flock should be kept reasonably young. The incidence of epididymitis is usually lower in young rams.

Fertility can be impaired by troubles such as fly-strike, head injury, abscess formation and grass seed trouble, particularly about the testicles. Even after recovery it may take two months to regain normal fertility. It is important also that the scrotum or purse should be free of wool, in order to prevent overheating.

The rams should receive regular attention throughout the year, and particularly within two months of mating. For mating they should be in good active condition and certainly not fat.

It is important to the lamb breeder that the lambing period should be as short as possible. Three per cent. of rams should be used to ensure this.

Interest has increased recently in the use of vasectomised or "teaser" rams, i.e., rams which have been operated upon, and rendered infertile but are still vigorous and able to serve. At the commencement of the breeding season and at that time only, the presence of rams in the flock tends to induce the great majority of the ewes to come into oestrus or heat during the third week after introducing the rams. Use of this fact is made by adding "teaser" rams to the flock for two weeks prior to the mating date decided upon, and then replacing them with the entire rams on that date.

A very suitable and common practice which effects the same result is to join one-third, i.e., one per cent. of rams for a fortnight before the mating date, and at the end of that time join the remainder. Such a mating procedure does not increase the percentage drop, but is likely to result in a more concentrated and earlier lambing.

After the mating period, the rams should be gone over for injury, condition and culling and the requirements for the following season determined.

The ewe flock also requires careful treatment. When culling, those with defective udders should be excluded, and also the non-breeders, i.e., those which have not lambed for two consecutive seasons.

As the lamb flock has been on good pasture during the late winter and spring period, the ewes, particularly crossbreds, are often overfat. For mating, they should preferably be in strong forward store condition. To allow time in which to reduce the condition of the ewes, it may be necessary to wean the last of the lambs a little early. It takes several weeks to reduce overfat crossbred ewes even on poor pasture.

FLUSHING

It has been shown that if ewes in suitable condition are increasing in bodyweight when mated, a greater number of twins will be dropped. This fact can be made use of by improving the nutrition level of the ewes for two weeks prior to joining the rams. As all ewes do not conceive at the first wave of oestrus, it is usual to continue this treatment for a further month or so. The practice is termed "flushing." A high level of nutrition is not required. Good paddock grazing is sufficient, particularly where meadow hay has been cut and left as grazing. Paddocks in which there are appreciable residues of grain from cereal crops are well suited for the purpose.

(To be concluded).

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CONSIDER THE LEMON

By MARGARET SPENCER

SURELY the lemon is one of the most useful of all fruits! We can use it in cooking and cleaning, and even in Milady's beauty care, and wise is the family that grows at least one lemon tree and so has "on tap" lemons at their best—picked fresh, full of juice and flavour and rich in Vitamin C.

To people on low calorific or restricted salt diets the lemon lends new zest to meals which all too frequently become drab and tasteless. Added just before eating, a generous squeeze of the juice brings out to the full the flavour of salads, meats and vegetables. Squeezed on meat before cooking lemon juice not only adds flavour but actually helps to tenderise it!

LEMONS IN COOKING

Grated lemon rind is practically a "must" in stuffing and, if used in cakes or biscuits made from clarified dripping, it quite disguises the fact that more expensive shortenings have not been used. And just a tip—thre's no need to waste the rind of lemons you use for drinks etc. If you grate it and store it in tightly-covered jars at refrigerator temperature you will have a delicious flavouring on hand to add to braised carrots, salad dressings and baked fruit puddings.

Of course you can always prepare from good clean ripe fruit the candied peel for your cakes and puddings and it will be beautifully moist and rich in flavour. Very thin strips of lemon rind—the yellow part only—will enhance the flavour of fricassees of chops, tripe or chicken and also stewed pears and apples.

THIRST QUENCHERS

Always popular for their refreshing and thirst-quenching properties are lemon squashes and if you keep two or three bottles of the concentrated syrup in the refrigerator you can use it as the base of many delightful drinks. Served with soda, ginger ale or other aerated waters it can be given added glamour with decorative ice cubes in which cherries or mint leaves have been set and a slice of lemon, orange or cucumber added as a final touch.

So many cakes and puddings feature lemons that it is easy to see what general favourites they must be. A cake which is welcome at afternoon tea table and in the lunch box for its "different" texture and flavour is the lemon coconut cake featured later in this article. Lemon icing teams well with spicy ginger cakes, cinnamon sponges and date slices too. It does not suffer from the defect of over-sweetness so common in many icings and fillings.

JAMS, JELLIES AND SWEETS

Used in jams and jellies, lemon not only adds to piquancy, but the acid and pectin content helps greatly toward ensuring a good "set," especially with over-ripe fruits and fruits low in natural pectin.

By the way, although lemons contain acid they do not as some people imagine, cause hyper-acidity. Rather do they help maintain the normal balance in the digestive juices.

In boiling sugar for sweets, a squeeze of lemon juice may take the place of cream of tartar or glucose in converting some of the sugar into invert sugars, so helping to prevent unwanted crystallisation of the syrup. Sweets in which lemon juice or cream of tartar have been used do not soften so quickly as those in which glucose is used, the last named being used mainly in sweets of the fondant type.

AS A CLEANING AGENT

But it is not only for its special qualities in cooking and garnishing foods that we value the fruit. If you have a pine-topped kitchen table you will find it benefits remarkably from a rub with cut lemons—even after most of the juice has been removed for another purpose. For best results, leave a few minutes before rinsing thoroughly with clean cold water. Your table will be much whiter. Your brass ornaments and taps will have a new shine if rubbed thoroughly with a cut lemon then rinsed and dried. No powder or paste to catch in crevices! Salt and lemon is one of the most effective cleaning agents in cleaning your copper, while a little lemon juice in the final rise when washing glassware gives a bright sparkle. When piano keys or ivory knife handles become discoloured clean with a paste made from lemon juice and whiting. In the laundry too, you will find lemon juice has its uses—for instance soaking in it will often remove ink stains.

AS A BEAUTY AID

As it helps toward a sparkling cleanliness in the home, so too, blonde hair has a bright lustre when lemon juice in the last rinsing water ensures that all traces of soap are removed. And nearly every housewife knows that even those lemons she has just squeezed for flavourings in puddings etc., can still work wonders on toil stained hands.

On and on the list could go, so many and varied are the uses to which this wonderful fruit can be put. Use lemons often, use them well, and you will have your reward in appetising meals and household tasks made easier.

LEMON COCONUT CAKE

Ingredients—

4 oz. butter.
4 oz. sugar.
6 oz. self-raising flour.
2 tablespoons coconut.
Juice of 1 lemon.
2 eggs.
Milk if necessary.

Method—

Soften butter slightly.
Add sugar and cream well.
Add beaten eggs gradually, beating well.
Add coconut, then lemon juice.
Fold in the sifted flour.
Add milk, if needed, to make a soft mixture.
Bake in a greased tin in a moderate oven about 25 minutes.
Cool, then ice with lemon icing and sprinkle with coconut.

LEMON SYRUP

Use 1 lb. sugar to each pint of lemon juice, to make this popular squash, the base of many good drinks.

Method—

Place sugar in saucepan with just enough water to wet the sugar thoroughly. Add 2 or 3 thin strips of lemon rind.
Stir over gentle heat till the sugar has dissolved. Allow to cool.
Strain and add to lemon juice. Bottle, and keep in the refrigerator.

Important.

You will spoil the flavour—and you will destroy most of the Vitamin C which lemons contain—if you boil the lemon juice.

SUMMER PUNCH

(A refreshing drink featuring lemon, mint and dry ginger ale).

Ingredients—

3 oz. castor sugar.
3 oz. tablespoons of water.
½ pint mint leaves.

1½ lemons.
1 pint dry ginger ale.
Crushed ice.

Method—

Put sugar and water in saucepan and heat till sugar dissolves. Cool.

Wash mint leaves well and place in a basin. Add syrup and the strained lemon juice.

Cover and allow to stand 1 hour in a cold place.

Just before serving, strain off the mint syrup on to crushed ice and add the chilled ginger ale.

LEMON PUDDING

(This is a delicious pudding which may be served hot or cold though it is nicest hot. Sliced bananas, cream or icecream may accompany it. And of course, if you want to prevent bananas from discolouring, use lemon juice again!)

Ingredients—

2 oz. butter or margarine.
4 oz. sugar.
2 eggs.
Rind and juice of 2 lemons.
2 oz. plain flour.
1 cup milk.

Method—

Cream butter, sugar and egg yolks thoroughly.

Add rind and juice of lemons.

Sift in flour.

Add milk.

Beat egg whites till stiff then fold into mixture.

Pour into pie-dish.

Stand pie-dish in a baking tin containing water and bake in a moderate oven, about 1 hour. (The pudding should be cake-like on top and lightly set, like a custard, underneath, and a light golden brown.)

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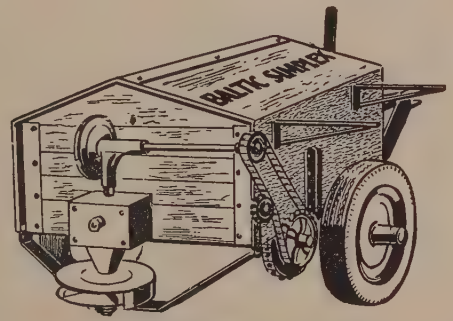

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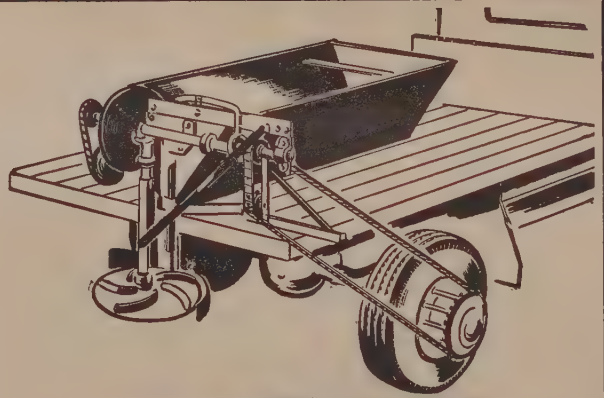

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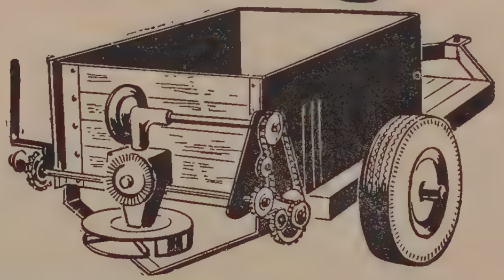

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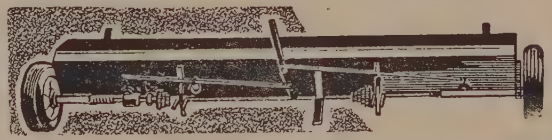

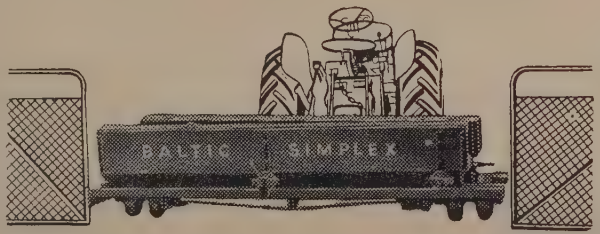

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PROGRESS IN THE CONTROL OF FOOTROT

By

C. R. TOOP, B.V.Sc.,
Chief Veterinary Surgeon

Fig. 1.—A moist, hairless patch between the claws of this foot shows that the footrot organisms are still active in the area. The claws are also mis-shapen, suggesting the presence of footrot lesions beneath the horn.

SEVEN years ago, action was taken for the first time in Western Australia for the control of footrot in sheep, and a good deal of progress has since been made. This work began in a small way for the purpose of preventing the spread of infection through markets, but it gradually gained momentum to reach its peak in 1955, and has now developed into an organised campaign for the total eradication of the disease.

Until about 15 years ago, it was the general belief that footrot was not amenable to control, since it appeared that sheep had only to be taken to areas of high rainfall and they would inevitably become affected. This belief was dispelled by the work of Beveridge, who, in 1941, was able to show that the infection is carried in the feet of the sheep where it is able to persist for a long period, but that it is unable to survive for more than about a week in the soil. Thus, by removing the carriers from an affected flock and transferring the remainder to a spelled paddock, it is possible to eradicate the disease, and furthermore a flock that is free of footrot will remain free indefinitely no matter how wet the conditions may be, provided no infection is introduced from an outside source. This knowledge has provided the basis for successful eradication.

MARKET INSPECTIONS

The control measures employed in Western Australia rest, in the first place, upon the regular inspection of markets, supported where possible by inspections of individual flocks. Quarantine is imposed wherever footrot is found to exist and it is maintained until the flock has been freed of infection. While a property is under quarantine no sheep are permitted to be removed from it except for the purpose of slaughter and they must be consigned either to the quarantine yards at Midland Junction or meatworks at Fremantle or Albany.

It is the purpose of these restrictions to protect clean flocks from infection and it would obviously serve little purpose to free a flock of the disease at considerable effort and expense and then to allow it to become re-infected by the indiscriminate purchase of sheep in the open market.

QUARANTINE YARDS

The quarantine yards at Midland Junction, which provide the main outlet for

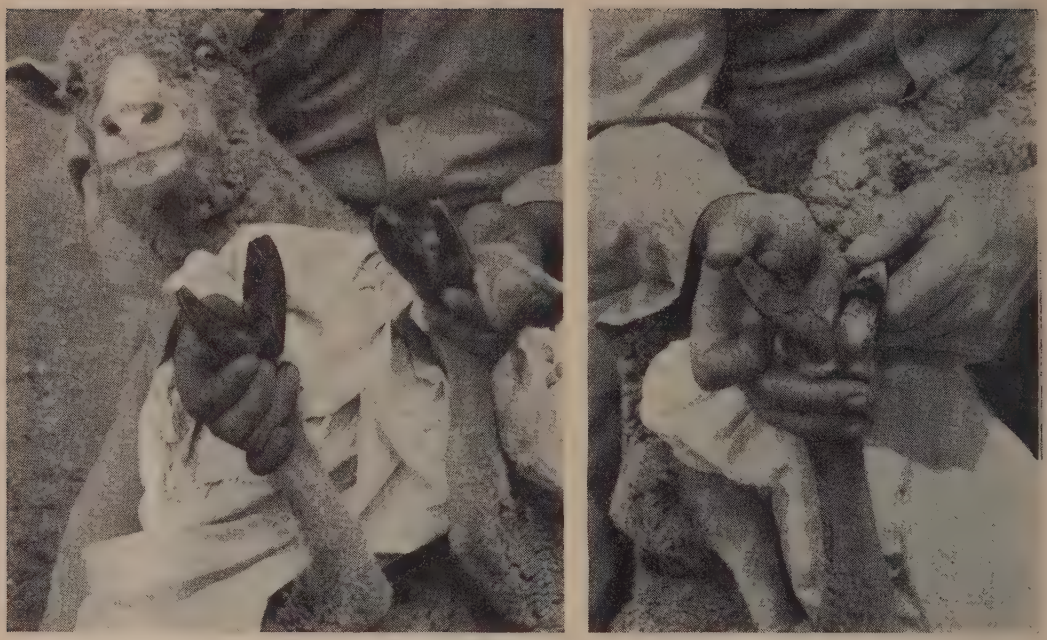

Fig. 2.—Both the inner claws on the hind feet of this sheep are malformed, with horny deposits on the inner surface. The outer claws on each foot are clean and healthy although somewhat overgrown. In the right-hand picture, one of the mis-shapen claws has been trimmed with the secateurs exposing a pocket of infection in which the footrot organisms are still active.

sheep from affected properties, have proved of great assistance in this respect. They are served by a separate railway siding as well as unloading ramps for road vehicles, which ensures there can be no contact either direct or indirect between known affected sheep and the sheep that may be purchased by graziers in the main saleyards. In addition, both rail and road vehicles are required to be thoroughly cleansed at washing bays provided for the purpose before they may be used for the transport of other sheep, and there are similar facilities at Fremantle and Albany. The greatest risk, however, lies in the purchase of affected sheep rather than from infections contracted during transit.

In the early stages of the campaign it was the custom when quarantines were imposed to provide the flock owner with full information and advice upon the application of control measures, but it soon became apparent that he could not be left to tackle the problem alone, and that the guidance and assistance of extension officers was necessary for success.

SUMMER ERADICATION

Emphasis has been placed upon summer eradication when, under the dry conditions which then prevail, the disease has ceased to spread and the percentage of affected animals has fallen to its lowest level. Summer eradication programmes, in which the majority of the affected flocks have participated, are organised in all districts and each of these flocks must receive a detailed examination. Every sheep must be turned up and every foot examined for the presence of infection.

Particular attention is paid to sheep with overgrown, misshapen feet which may contain active lesions or hidden pockets of infection, as well as to sheep with moist hairless areas between the digits. These are the carriers of infection and, if retained in the flock, they will give rise to a further outbreak in the following spring.

They must be removed and segregated either to be sold for slaughter, which is encouraged since it results in the immediate elimination of infection from the property, or to be held as a hospital flock for curative treatment.

Fig. 3.—The foot on the left of the picture is clean and healthy and quite normal in appearance. The other foot has a mis-shapen claw with a moist infected patch extending into the coronet above the cleft of the foot. Later in the summer, the skin condition would probably clear up without attention, but infection might still lurk in the malformed claw unless this was trimmed down and treated.

This treatment involves thorough paring of the feet so as to uncover all infected surfaces, followed by repeated immersion in a formalin footbath or painting with chloromycetin or cetrimide, both of which have proved very effective.

The clean or unaffected portion of the flock is passed out through the footbath into a spelled paddock and a further inspection is made about a month later to make doubly sure that no carriers have escaped detection.

Sheep from the hospital flock, when cured, are returned to the main flock after a period of observation and those that do not respond to treatment are sold for slaughter. The flock is then kept under observation during the following winter and spring and it must remain free of footrot throughout this period before a release from quarantine is granted.

The bulk of this eradication work is carried out by District Stock Inspectors. It is a hard, exacting task and it is only necessary to miss a single carrier for a breakdown to occur.

Some owners have preferred to eradicate the disease by selling the whole of the flock for slaughter and restocking with clean sheep from dry inland areas after spelling the property for a fortnight, but difficulties associated with the purchase of suitable replacements have made this practice less attractive during the past couple of years.

SOME ENCOURAGING FIGURES

Since the campaign began, 556 flocks have been found with footrot and 474 of them have been freed of the disease and, with a few exceptions, have since remained free. At Geraldton where there were 39 affected flocks the disease has been completely eradicated, while in the Bridgetown area only 18 of the 189 flocks which were found to be affected still remain under quarantine restriction, and similar if less spectacular results have been obtained in other districts. 139 flocks were included in the summer eradication programme for 1956 and 98 of them were freed of footrot. In some instances where eradication was not achieved there was lack of co-operation on the part of the owners, while in others, failure was ascribed to defective fencing or incomplete mustering, but there can be no doubt that carriers were missed in some flocks.

There are now 82 properties under quarantine, at least 74 of which will be included in the 1957 eradication programme, and it is confidently expected that a further substantial reduction of the number of affected flocks will result by the end of the year.

The only discordant feature has been the occurrence of new outbreaks, 59 of which were reported in 1956, indicating there are pockets of infection still to be revealed. It is reasonable to anticipate, however, that these outbreaks will progressively decrease as the disease is eradicated from the known infected flocks and new infections are eliminated as they are detected.

I think it can now be claimed that the disease has been brought under control and that its incidence can be reduced to a level where it will cease to be a serious problem. The total eradication of an infection which may be dormant in the feet for several years only to become active upon exposure to wet conditions is, however, a very difficult assignment and it remains to be seen whether it can be achieved.

(A Country Hour talk, published by courtesy of the Australian Broadcasting Commission.)

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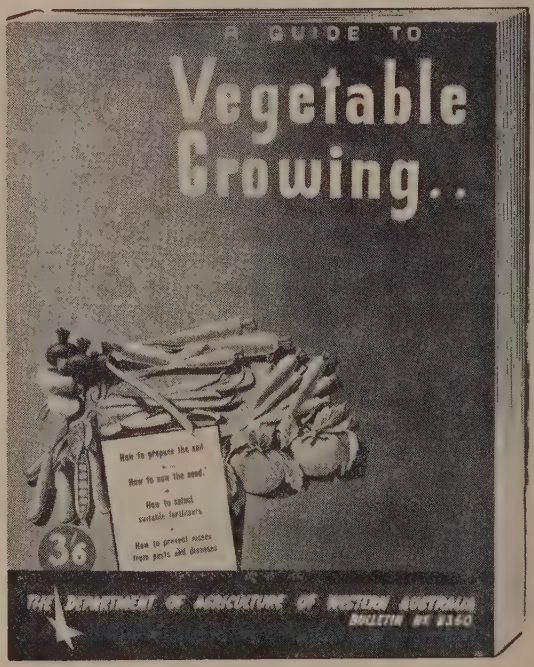
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BOOKS... *for FARMERS*

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AN INTRODUCTION TO STATISTICAL SCIENCE IN AGRICULTURE, by D. J. Finney. Copenhagen, 1953.

AGRICULTURAL MACHINERY

DIRECTORY OF WHEEL AND CRAWLER TRACTORS PRODUCED THROUGHOUT THE WORLD, 1955. Food and Agriculture Organisation of the United Nations. [Rome] 1955.

FIELD CROPS

GRASSLAND FARMING, by G. H. Serviss and G. H. Ahlgren. N.Y./Lond., 1955.

CROP MANAGEMENT

AGRICULTURE ECOLOGY, by G. Azzi. Lond., 1956.

SOILS AND FERTILISERS

COMPOST, FOR GARDEN PLOT OR THOUSAND-ACRE FARM, by F. H. Billington. 4th Ed. Lond., 1956.

CONSERVING SOIL, by M. D. Butler. Princeton (N.J.), 1955.

DISEASES AND PESTS

PESTICIDE OFFICIAL PUBLICATION AND CONDENSED DATA ON PESTICIDE CHEMICALS, 1955. Association of American Pesticide Control Officials, Inc. College Park (Md.), 1955.

TOBACCO DISEASES, WITH SPECIAL REFERENCE TO AFRICA, by J. C. F. Hopkins. Kew (Sy.), 1956.

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CITRUS-GROWING IN AUSTRALIA, by F. T. Bowman. Syd., 1956.

DWARF FRUIT TREES, by L. Southwick. N.Y., 1948.

FORESTRY

LAND OF TANE: THE THREAT OF EROSION, by R. St. B. Baker, Lond., 1956.

TREES, WOOD AND MAN, by H. L. Edlin. Lond., 1956.

LIVESTOCK

ANIMAL NUTRITION, by L. A. Maynard and J. K. Loosli. 4th Ed., N.Y., 1956.

BLACK'S VETERINARY DICTIONARY, by W. C. Miller and G. P. West. 4th Ed. Lond., 1956.

THE FARMER'S YEARBOOK: ENCYLOPAEDIA & DIRECTORY OF PEDIGREE BREEDERS: 3rd ISSUE [1956] —. Tibberton (Glos.), [1956]—

MANAGEMENT AND FEEDING OF SHEEP, by E. T. Baker. N.Y. 1947.

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SURVEY OF BEEF CATTLE PRODUCTION IN VICTORIA AND AGRICULTURAL DISTRICTS OF WESTERN AUSTRALIA. Australia. Bureau of Agricultural Economics. Canb., 1955.

SWINE PRODUCTION, by W. E. Carroll, and J. L. Krider. 2nd Ed. N.Y., 1956.

DAIRYING

BRITISH FRIESIANS: A HISTORY OF THE BREED, by J. K. Stanford. Lond., 1956.

A DICTIONARY OF DAIRYING, by J. G. Davis. 2nd Ed. Lond., 1955.

GOOD MILK FARMING, by H. G. Robinson. Lond., 1946.

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DISEASES OF POULTRY, by E. A. Gray. 4th Ed. Lond., 1955.

DUCKS: BREEDING, REARING AND MANAGEMENT, by R. Appleyard. 4th Ed. Lond. [1949].

A HANDBOOK TO POULTRY PRACTICE, by K. Wilson. Lond. [1953].

HEN BATTERIES, by W. P. Blount. Lond., 1951.

MODERN POULTRY HUSBANDRY, by L. Robinson. 3rd Ed. Lond., 1953.

PROFITABLE POULTRY MANAGEMENT, by C. E. Lee and Others. 21st Ed. [Cayuga (N.Y.)] 1954.

SECRETS OF SUCCESSFUL POULTRY-KEEPING, by G. R. Scott. 3rd Ed. Lond., 1948.

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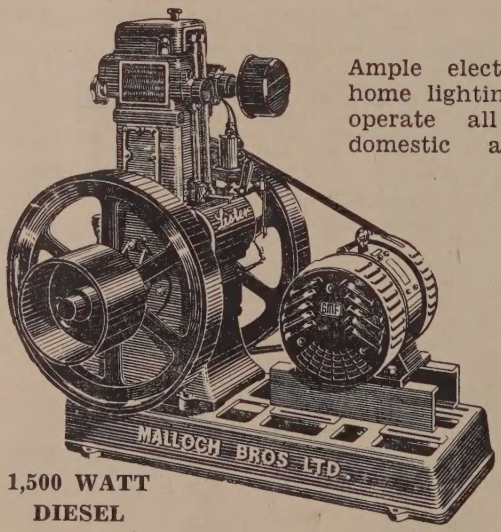

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By P. M. A. HARWOOD, M.R.C.V.S., Senior Veterinary Surgeon

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Sheep develop cysts after grazing areas contaminated by infected dog or fox droppings.

Cysts may develop up to more than 6in. in diameter and in the sheep are usually found in the lungs and liver. Although relatively harmless to the sheep, **these cysts can also develop in the organs of human beings, where the effects are most serious.**

Humans pick up eggs from two main sources. Dog droppings eventually dry to dust and this dust may contain living eggs. Unwashed lettuce grown on farms may be contaminated with this dust. But the greatest danger is to children who play with dogs and then eat or lick their fingers without washing their hands. Dogs often have tapeworm eggs adhering to their coats and are a potent source of infection.

PRECAUTIONS TO TAKE AGAINST HYDATID DISEASE

Prevention depends on three main principles.

1. Never give dogs raw offal of any description.

As stated previously, one living cyst may contain hundreds of tapeworms. Raw offal such as heart, lights and liver is made absolutely safe by boiling for ten minutes.

2. Treat dogs regularly for tapeworms.

The treatment of choice is with Arecoline hydrobromide and is carried out as follows:—

(a) The dog is starved for 12 to 18 hours.

(b) Arecoline hydrobromide is given by mouth in tablet form or dissolved in a small quantity of water.

Dose Rate—

	Grain.
Dogs of terrier size	¼
Dogs of sheepdog size	½
Kangaroo dogs	1

NB.—Although Arecoline hydrobromide is very violent in its effects, resulting in severe purging, it is a very safe drug and is far more effective against Hydatid tapeworms than other and less violent tapeworm medicines.

Worming should be carried out at least every six months.

3. Always wash your hands after handling dogs and impress the importance of this practice on your children.

4. Always wash salad vegetables grown on farms where sheep are raised.

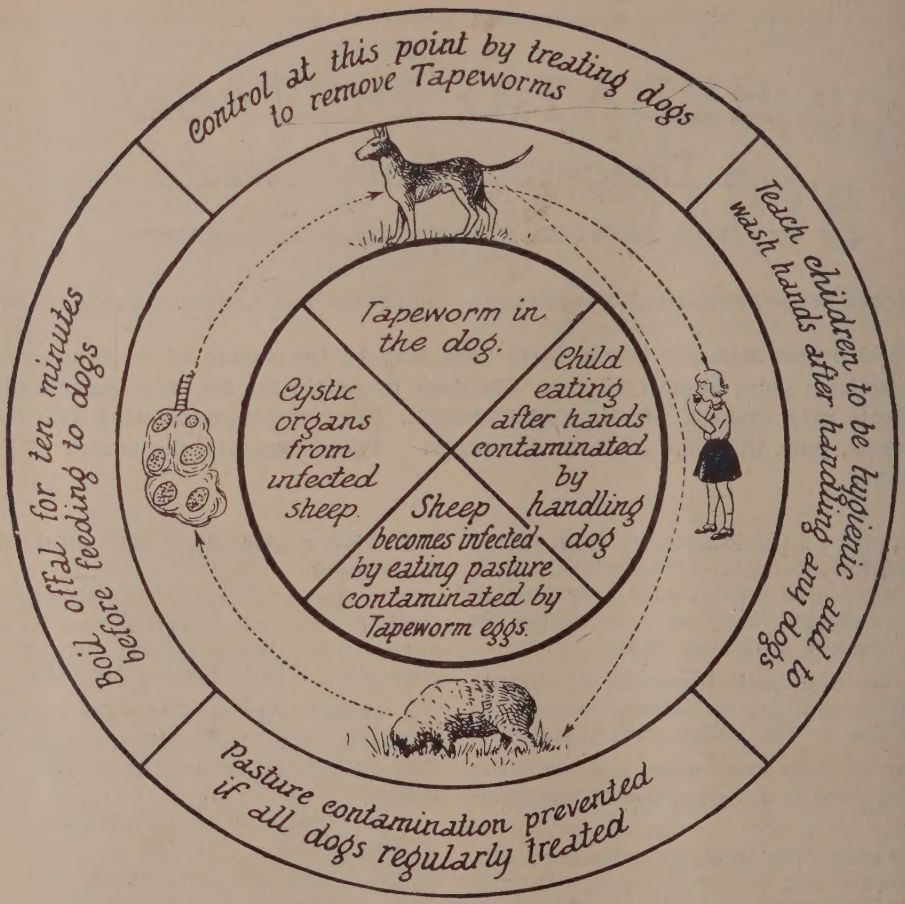
Control at this point by treating dogs to remove Tapeworms
Teach children to be hygienic and to wash hands after handling any dogs
Pasture contamination prevented if all dogs regularly treated
Boil offal for ten minutes before feeding to dogs
Tapeworm in the dog.
Child eating after hands contaminated by handling dog
Sheep becomes infected by eating pasture contaminated by Tapeworm eggs.
Cystic organs from infected sheep

Diagram showing the life cycle of the dog tapeworm, with recommended control measures for hydatid disease.

Note.—Town dogs do not have much opportunity of picking up Hydatid worms. All meat and offal at abattoirs is inspected and any organs containing Hydatid cysts are condemned. **The risk of this disease occurs where sheep are raised.**

SUMMARY

1. Hydatid disease is a serious and sometimes fatal disease affecting humans.
2. The disease is transmitted by dogs.
3. Dogs are infected by eating raw offal containing cysts.
4. Offal fed to farm dogs MUST be boiled.
5. Always wash your hands after handling dogs and impress the importance of this on your children.
6. Worm the dogs regularly with Arecoline hydrobromide.
7. Wash salad vegetables.